THE BRITISH YOUTH's INSTRUCTOR:

Or, A New and Easy GUIDE to PRACTICAL ARITHMETIC.

WHEREIN THE
Rudiments of common ARITHMETIC, VULGAR
and DECIMAL FRACTIONS, the Extraction and
Uſe of the SQUARE and CUBE ROOTS, &c.
Are ſo eaſily Treated of, and ſo plainly Demonſtrated,
That any Perſon may, of himſelf, (in a ſhort Time) become
acquainted with every Thing neceſſary to the
KNOWLEDGE OF BUSINESS.

WITH A POSTSCRIPT,
For the USE of COUNTRY YOUTHS in particular:
Shewing how to meaſure any regular Piece of Timber, Tiling,
Thatching, Brick-work, or Piece of Land; as alſo how to gauge
any Ciſtern, Piece of Malt, or common Cooler, Tub, &c.

To which is added,
A compendious METHOD of BOOK-KEEPING,
Whereby all Perſons capable of ſubtracting one Sum of Money from another, may ſtate and balance their own Accounts correctly, and have a clear View of all their Tranſactions.

The Whole deſigned for ſuch as have hitherto neglected, or have not had an Opportunity of becoming acquainted with Figures; and attempted in natural and familiar Dialogues, in order to render the Work more eaſy and diverting, as well as uſeful to Learners.

RECOMMENDED BY SEVERAL
Eminent WRITING-MASTERS and ACCOMPTANTS.

By DANIEL FENNING,
Author of the Young ALGEBRAIST'S COMPANION; Deſcription and Uſe of the GLOBES (both in Dialogues); the Univerſal SPELLING-BOOK; Royal Engliſh DICTIONARY; Young Man's BOOK of KNOWLEDGE; a new Engliſh GRAMMAR; and a new Treatiſe on MENSURATION.

The ELEVENTH EDITION, reviſed, corrected, and improved,
By W. BURBIDGE, SCHOOLMASTER, in *Saliſbury*.

LONDON:
Printed for S. CROWDER, PATER-NOSTER-ROW.
M.DCC.LXXXVII.

[Price bound Three Shillings.]

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DEDICATION

To the SCHOOLMASTERS of

Great-Britain and *Ireland.*

GENTLEMEN,

THE great demand for, and ſpeedy ſale of, the five laſt impreſſions of this ſmall Treatiſe, naturally leads me to think, that many of you have encouraged the undertaking.

Permit me, therefore, in this ſixth edition, to return you hearty thanks for your friendly and undeſerved favours.

I am very ſenſible (as I told you before) that many abler hands have undertaken this taſk before me, and have, in large volumes, done *that* which cannot be expected to be found here: but as you are ſenſible too many of them have ſpent their time rather upon curioſities than buſineſs (the very thing that every ſcholar ſhould particularly drive at, and which, I am ſenſible, every one of you would promote the knowledge of) I have here made it my chief care to inform the learner of every thing that is neceſſary thereto.

It was not without reluctance that I appeared upon this ſubject; but having publiſhed a ſmall Treatiſe of FRACTIONS and ALGEBRA, by way of dialogue, in 1759,* which has met with great encouragement, I was perſuaded by ſeveral Schoolmaſters, and private gentlemen, to publiſh alſo a Piece of ARITHMETIC, after the ſame manner; as they were ſenſible, they ſaid, (and indeed, I confeſs, I think the ſame) that this way of writing conveys the matter better, and communicates things ſooner to the learner, than the bare ſetting of ſums, and not working them at all, or in a dry intricate manner.

As I do not pretend to recommend the work by comparing it with other authors, ſo, I hope, you will not condemn it, till you have peruſed it throughout.

'Tis true, that the laſt method of reducing *C's. qrs. lbs.* into *lbs.* (in the 1ſt example of *Tare and Tret*) is well worthy your obſervations, it being as eaſy as it is new; and ſeveral perſons in buſineſs, to whom I have communicated it,

never

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* The fifth Edition, with ſome Quadratic Problems, is juſt publiſhed.

BRITISH MUSEUM 28 FEB 67

never pretend to uſe any other way for eaſe and expedition.

To ſuch of you, indeed, as are perfect maſters of the ſciences, this little piece may appear inſignificant; but to others, I am ſenſible, the Dialogues will be of great ſervice, as they are intermixed with a variety of friendly examples, in natural converſation; and I perſuade myſelf, they will be of great help to your pupils, and, in a great meaſure, eaſe you of that heavy taſk, which every diligent maſter (with a number of ſcholars) muſt of neceſſity labour under.

This, Gentlemen, is one reaſon (as I ſaid) why I built it upon this plan; and I hope, for the deſign's ſake, you will forgive thoſe errors that have yet eſcaped my notice, and which you know are ſo common to a work of this ſort; though I have taken care to correct all ſuch as I have at preſent diſcovered in the former editions.

I have made no great alteration in the work, only have taken off part of the Double Rule of Three *Direct* and *Reverſe*, (as you know the Rule of Five Numbers will ſupply that defect) in order to make more room (by the deſire of ſeveral merchants) for a fuller and more clear explanation, both of the true and cuſtomary way of Diſcount.

To my thanks, I add my beſt wiſhes for your ſucceſs, jointly and ſeparately, in your ſeveral undertakings; and deſire always to ſubſcribe myſelf,

GENTLEMEN,

Your moſt obliged humble Servant,

D. FENNING.

Royal Exchange Aſſurance-Office,
London, Sept. 1, 1767.

PRE-

PREFACE

TO THE

FIFTH EDITION.

Kind Reader,

I Here preſent you with the fifth edition of my ſmall Treatiſe of Arithmetic, which I have improved, and endeavoured to render as plain as time, room, and opportunity would admit of.

For ſuch of you who have too much neglected this branch of education, and for others who have neither time nor opportunity to apply to a proper maſter, the following work was chiefly deſigned, and was at firſt carried on no farther than the *Rule of Three Direct*: But I conſidered with myſelf, that it might fall into the hands of many, who would be glad to have a notion of *Fractions*. I have, therefore, to ſerve you, treated upon moſt of the Rules of *Arithmetic*, and for the ſake of thoſe that live in the country in particular, I have given ſome inſtructions to meaſure timber, or a common piece of ground; as alſo to gauge a caſk or piece of malt, and ſeveral other uſeful and practical examples, which, I am perſuaded, will be of ſervice to you.

One thing, which is ſeldom taken notice of in a PREFACE, I would have every one of you, that are learners, to obſerve, and that is, that if, upon the trial of any ſum or queſtion, you do not find it the ſame as the anſwer, do not let that diſcourage you; for if you examine your own work after you have done it, and are ſo much maſter of the rules as to know when you are right or wrong, you may conclude you are right, whatever anſwer you may find in my work, or any other author's: but before you determine this, mind and be ſure your own work is right.

As to ſuch of you that have little or no notion of figures, if you have a mind to learn, I am ſenſible you may very eaſily do it, with little or no trouble; for I have taken the more pains, that you might have the leſs: and if it does but anſwer the end of inſtructing ſuch of you as are quite ignorant, and improving others that have already ſome knowledge of figures, I ſhall look back upon the undertaking with pleaſure, notwithſtanding thoſe mean criticiſms and remarks that may be made upon ſuch overſights which can hardly be avoided in a work of this ſort.

But every impartial reader well conſider the nature and deſign of the work; for 'tis the plan upon which it is built that is to be minded: if *this* be plain and eaſy (as I hope it is) there is no fear but the learner will find a ſenſible ſatisfaction, and the work will be crowned with ſucceſs.——As for ſuch *Carpers* that are reſolved to amuſe themſelves with the bone only, they are extremely welcome; but let them be civil, and not ſnarl at thoſe who would eat the fleſh quietly.

I am,

Kind READER,

Your humble Servant,

And Well-wiſher,

D. FENNING.

London, Sept. 1, 1767.

PREFACE

TO THE

TENTH EDITION.

THE number of editions this work has been honoured with muſt be an evident proof of its *utility*. Mr. *Fenning*, the original author, has now paid that debt which all muſt pay. But, where is that man who can ſay no one can improve upon what I have ſubmitted to the eye of the public? The queſtion ſeems to anſwer itſelf. Having therefore received ſo much encouragement of the editions already publiſhed, the Proprietors were ſtimulated to make it more univerſally uſeful.

Perſons who have learnt to work the ſeveral rules of Arithmetic may be deſirous of knowing the *Art of Book-Keeping*; and it has been ſuggeſted, that ſomething of that kind would be a conſiderable addition. In compliance with this intimation, amidſt a variety of other improvements, we have added, *A conciſe Method of keeping Books*, which Mr. Burbidge, the preſent Editor, has taught with the greateſt ſucceſs for ſeveral years, and found always approved of by thoſe who have received his pupils into their Compting-Houſes. Mr. Burbidge, in this reſpect, has not only anticipated the wiſhes of his peculiar friends, but has gone beyond them, as he has made many corrections in the body of this work, which, we hope, will meet with the patronage of thoſe who wiſh to encourage an *enlargement*, or *amendment*, of any work, which has been honoured with ſo many repeated proofs of its utility.

PREFACE

TO THE

ELEVENTH EDITION.

THE Proprietors of this uſeful compendium of Arithmetic gratefully acknowledge the preference of a liberal public, through ten large editions. They are happy to know that the labours of Mr. BURBIDGE have met, in a peculiar manner, the approbation of their patrons. This impreſſion has alſo been printed under his immediate correction, ſo that they preſume to think it will be found throughout equally correct as any paſt edition, and perhaps in ſome parts ſuperior. In the mechanical part, no pains or expence have been ſpared to do juſtice to the abilities of the editors, and render their labours in all reſpects of public utility.

To

To the PUBLIC.

WE, whoſe Names are hereunto ſubſcribed, having peruſed the plan of this little Treatiſe of ARITHMETIC, do allow the Dialogues to be very well adapted to the purpoſe; and as the rules and examples are laid down in a natural, eaſy, and familiar manner, we beg leave to recommend it, as the moſt uſeful and eaſy book for learners extant.

Edmund Anguiſh, *Accomptant*
James Barclay, *Writing-maſter*
William Bently, *Surveyor*
George Coles, *ditto*
Mr. Coulthiſt, *of the Academy, Preſcot-ſtreet, Goodman's-fields*
Henry Deacon, *Accomptant*
Randal Evans, *Writing-maſter*
Anthony Gilbert, *Surveyor*
Edward Griffiths, *ditto*
Samuel Hill, *Philom.*
T. Humphreys, *Writing-maſter*
Thomas Hughes, *ditto*
Samuel Hornby, *ditto*
Timothy Langley, *Accomptant*
Abraham Longden, *ditto*
Abraham De Lier, *Philom.*
Thomas Newbery, *ditto*
John Quant, *Writing-maſter*
Wm. Richardſon, *ditto*
David Rowland, *Accomptant*
John Smyth, *Writing-maſter*
Jonas Smith, *ditto*
Thomas Smithe, *ditto*
John Smythe, *Accomptant*
Zachary Snaper, *ditto*
Eraſmus Turner, *ditto*
J. Thompſon, *Writing-maſter*
James Thurſton, *ditto*
Daniel Trunker, *ditto*
William Thorley, *ditto*
James Thorpe, *ditto*

To the RECOMMENDERS.

GENTLEMEN,

I Return you hearty thanks for the honour you have done me, by the favour of your names to this little Treatiſe: let me crave your further aſſiſtance in noting down thoſe errors that you may occaſionally find, and you will ſtill further oblige, GENTLEMEN,

Your very humble Servant,

Sept. 24, 1767. DANIEL FENNING.

AN EASY GUIDE TO Practical ARITHMETIC.

The INTRODUCTION.

CHAP. I.

DIALOGUE I.

Between PHILO, *a Tutor, or Maſter, and* TYRO, *a young Scholar; concerning the Rudiments of Arithmetic.*

TYRO *viſits* PHILO.

Tyro. DEAR Sir, I am your very humble ſervant.—You will pardon me, I hope—I hear you have done inſtructing *Tyrunculus*, and I am come to lay claim to a former promiſe of your giving me a better notion of common *Arithmetic*.

Philo. You pleaſe me very much, young *Tyro*, I aſſure you, to ſee you ſo willing to learn; but I hear you underſtand the firſt four rules already.

Tyro. When I was at ſchool I had ſome knowledge of them, as I thought; but it was not well grounded; and when I left ſchool, inſtead of practiſing at home, and making myſelf maſter of what I learnt there, I bent my mind to play and idleneſs, like other naughty boys, and were it not for your kind offer, I ſhould know the want of it too late. I chooſe, therefore, ſir, to begin at the very loweſt branch, that I may ſee the reaſon of what I am doing, and not learn by rote, as too many ſchool-boys do, to the great diſcredit of their maſters, grief of their parents, and their own future ruin.

Philo. You ſay very right; for in beginning again you will be confirmed in what you know already; for I ſhall proceed with you the ſame as if you never had began, that others may be the better informed; therefore, for their ſakes do not you be angry, if I ſhould dwell upon ſome things longer than you may think there is occaſion for, ſince I tell you the reaſon before hand.

Tyro. Far be it from me, ſir, to take it amiſs; for though I do know ſomething of the firſt four Rules, I am ſenſible there are many thouſands who know nothing of the matter, and you do well to conſider them alſo.

Philo. I am glad, *Tyro*, to ſee you ſo conſiderate; it gives me great hopes of your being maſter of what I am about to inſtruct you in.

DIALOGUE II.

SECTION I.

OF NUMERATION, ADDITION *of Whole Numbers, Money, Weights,* and *Meaſures,* &c.

Tyro. WHAT is *Numeration*, and what does it teach?

Philo. Numeration is the true diſtinction and pronunciation of number; that is, it teaches us to write down, read, and expreſs any number or numbers whatſoever. For the better underſtanding of which, obſerve the following table.

N. B. The letter C ſtands for an hundred, and X for ten.

TABLE.

	C of Millions.	*X of Millions.*	*Millions.*	*C of Thouſands.*	*X of Thouſands.*	*Thouſands.*	*Hundreds.*	*Tens.*	*Units.*
Places	9	8	7	6	5	4	3	2	1
	9	8	7	6	5	4	3	2	1
		9	8	7	6	5	4	3	2
			9	8	7	6	5	4	3
				9	8	7	6	5	4
					9	8	7	6	5
						9	8	7	6
							9	8	7
								9	8
									9

NOTE 1.

This table you ought to get by heart, at leaſt, ſo as to underſtand the nature of it.

Caſt your eye now, *Tyro*, upon it; you ſee that there are nine places of figures from units to hundreds of millions. All the figures under the firſt row are units; thoſe in the ſecond row towards the left-hand, are under the place of tens; all in the third row are called hundreds; thoſe in the fourth row thouſands, &c.

Now, in order to know the value of, or how to expreſs any number in the table, I begin at the top figure towards the right-hand, and ſay units (1);

then units, tens, (twenty-one, 21;) then units, tens, hundreds, (three hundred and twenty-one, 321:) thus I go on, and find the fourth figure (viz. 4) under the place or name of thouſands, and accordingly, I call it four thouſand, which joined to the other three figures, will be four thouſand, three hundred, and twenty-one, 4,321. The fifth figure being in the place of tens of thouſands, is thus read: fifty-four thouſand, three hundred, and twenty-one, 54,321. Thus proceed, till you come to the laſt figure of all towards the left-hand (which ſtands in the place of hundreds of millions) and you will eaſily perceive, that thoſe nine figures are thus expreſſed: Nine hundred eighty-ſeven millions, ſix hundred fifty-four thouſand, three hundred and twenty-one, 987,654,321. Read this once more, and obſerve the commas or ſtops that are put to the figures, for they anſwer to, or correſpond with the ſtops in the words that are written out at length.

NOTE 2.

You are further to obſerve, *Tyro*, that the *Numeration-table* is not always ſet with theſe figures juſt in the form they here ſtand; for had they been any other nine figures, they are numbered and expreſſed after the ſame manner: For inſtance, ſuppoſe they were 1,2,3,4,5,6,7,8,9, this is expreſſed after the ſame manner, only inſtead of 987 million, it is now 123 million; inſtead of 654 thouſand, it is here 456 thouſand; and inſtead of 321, it is now 789. So alſo, 999,999,999, is read thus: Nine hundred ninety-nine million, nine hundred ninety-nine thouſand, nine hundred and ninety-nine, &c. So that you ſee it is only having a due regard to the places under which the figures ſtand; for you may ſee that after the firſt three places of figures (*viz.* units, tens, and hundreds) the next three places have the name of thouſands, the next three the name of millions, as you may obſerve by the following Table, which, I believe, will be of ſervice.

TABLE

TABLE 2.

Millions Place.			Thouſands Place.			Hundreds.	Tens.	Units.
1	2	3.	4	5	6.	7	8	9
	1	2.	3	4	5.	6	7	8
		1.	2	3	4.	5	6	7
			1	2	3.	4	5	6
				1	2.	3	4	5*
					1.	2	3	4
						1	2	3
							1	2
								1

Now here you ſee they are divided by ſtops or periods, which is certainly a help to the expreſſing the numbers: thus, ſuppoſe I would expreſs the number againſt which this mark (*) is placed, I find the *twelve* ſtands under the place of thouſands, ſo that I ſay it is twelve thouſand, three hundred and forty-five, &c.

Tyro. I perceive it, ſir, very plainly; but pray what uſe are cyphers of; or are they of no ſignification?

Philo. Cyphers are of no ſignification when they ſtand alone, (thus 000, or 0000, all ſtand for nothing:) nor are they of any ſignification placed before any figure or figures; thus, 02 is but 2; and 0005 is but five ſtill: but when cyphers are put after figures, it makes the number ten, twenty, thirty, a hundred, or a thouſand times more in value. Thus 1, by adding a cypher, it is (10) ten; add two cyphers, thus, 100, it is an hundred, &c. as by the following table.

TABLE 3.

1	One.
10	Ten.
100	An hundred.
1000	A thouſand.
10000	Ten thouſand.
100000	An hundred thouſand.
1000000	A million.
10000000	Ten million.
100000000	An hundred million.
1000000000	A thouſand million,
10000000000	Ten thouſand million.
100000000000	An hundred thouſand million.
1000000000000	Million of millions.

And thus you may go on as far as you pleaſe.

Tyro. I perceive it; but who could tell the value, or expreſs ſo many figures out of the courſe of the table?

Philo. You talk like a learner indeed. You ſee the twelfth figure, by the above table, has the name of an hundred thouſand millions; therefore were there 3, 4, or 5 times, or 5 hundred times as many figures, it would be as eaſy to number them in order, as well as if there were but 5 in all.

Tyro. That is a little ſurpriſing to me, I confeſs; for ſome think they do great things to number 9 or 10 figures only.

Philo. Well, *Tyro*, we will not call that pride altogether; for pride is good in learners ſo far as it tends to emulation only; that is, an earneſt deſire to excel in learning: but pray obſerve, ſuppoſe I had ever ſo many figures to number; you plainly ſee, by the laſt table, that the ſeventh figure is millions place, and that the thirteenth place has the name of millions of millions; ſo alſo the nineteenth figure would be millions of millions of millions: But as the word millions would be repeated ſo often in a very large number of figures, as to render it tireſome, there is a ſhorter and much eaſier way of expreſſing the number by certain words, which anſwer to every ſeventh figure, and to any degree of millions, as appears by the following Table.

TABLE 4.

Dots.	
1	The 7th figure from the units place is millions.
2	13 is bimillions, or millions of millions.
3	19 is trimillions, or the 3d deg. of millions.
4	25 is quartrillions, or the 4th deg. of millions.
5	31 is quintillions, or the 5th deg. of millions.
6	37 is ſexquillions, or the 6th deg. of millions.
7	43 is ſeptillions, or the 7th deg. of millions.
8	49 is octillions, or the 8th deg. of millions.
9	55 is nonmillions, or the 9th deg. of millions, or millions nine times repeated, &c.

Suppoſe it were required to number the 57 following Figures, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321, 987, 654, 321.

Here I make a period or dot over every ſeventh figure, and find there are nine dots in all: Then ſearching in the above table, I find the ninth dot to bear the name of nonmillions, the eighth of octillions, &c. Therefore, I number the above figures thus; 321 nonmillions, 987 thouſand; 654 octillions, 321 thouſand; 987 ſeptillions, 654 thouſand; 321 ſexquillions, 987 thouſand; 654 quintillions, 321 thouſand; 987 quartrillions, 654 thouſand; 321 trimillions, 987 thouſand; 654 bimillions, 321 thouſand; 987 millions, 654 thouſand, 321. And thus you may go on to as many more places, *&c.* Or you may number them by the ſecond part of the table, and that is, by putting ſmall figures where the dots ſtand, as 1, 2, 3, 4, till you come to 9: Then begin, and ſay $\overset{9}{321}$ of the 9th degree of millions, 987 thouſand; $\overset{8}{654}$ of the 8th degree of millions, *&c.* till you come to the end: And thus, by putting ſmall figures over every ſeventh figure, you may number to the 20th, 30th, or any higher degree of millions whatſoever.

Tyro. I underſtand you well; and though it is likely there may never be ſo many figures in any ſum; yet, it is good to know how to number them when a queſtion is aſked, though it be for fancy's ſake only. But now, *Philo*, if you pleaſe, I will aſk you a few queſtions, which I am at a loſs to know.

Queſt. 1. How is *eleven thouſand*, *eleven hundred*, and *eleven*, ſet down in 5 figures?

Philo. I know this is a common queſtion, and it is eaſily done, if you conſider; for this is the anſwer, 12,111, *viz.* twelve thouſand, one hundred and eleven.

Proof by ADDITION.

Eleven thouſand is	11,000	add
Eleven hundred is	1,100	
Eleven is	11	
Anſ.	12,111, as above	

Queſt. 2. How is *fifteen thouſand*, *fifteen hundred* and *fifteen*, ſet down in five figures? *Anſwer* 16,515.

But you are to obſerve, *Tyro*, that though theſe oddities are eaſily anſwered, you ſee; yet I would not have you be concerned with them; becauſe they are very badly expreſſed, and are an abuſe of language: for, ſuppoſe you ſtood indebted to me, and ſhould aſk me what it was, and I ſhould ſay fifteen pounds, fifteen ſhillings, and fifteen pence, would you not think it much better to ſay fifteen pounds, ſixteen ſhillings, and three pence? Take this then for a rule, *Tyro*, that, that is the beſt method of expreſſion, that is the ſhorteſt, freeſt, and moſt natural. Therefore, though the aforeſaid numbers run a little ſmoother in words than what I have now mentioned, (the reaſon of which is, becauſe they are each but one whole number) yet is the ſenſe of expreſſing fifteen thouſand, fifteen hundred, and fifteen, very little better than fifteen pounds, fifteen ſhillings, and fifteen pence.

☞ Now there are ſeveral things a little dark in expreſſion, relating to numbers, which are actually of uſe when they are known. I imagine, *Tyro*, you now and then read good books: You remember we read in the book of Kings, and in Iſaiah, that an Angel deſtroyed in the camp of the Aſſyrians, an hundred, and fourſcore and five thouſand. How do you ſet this down properly?

Tyro. Why really, ſir, I am at a loſs; and I have ſeen older perſons than myſelf puzzled at it.

Philo. So have I; but it muſt be for want of conſidering. Is not four ſcore and five the ſame as 85? Therefore, the number is one hundred eighty-five thouſand, thus, 185,000.

Again, you read in the Revelations, of a multitude of ten thouſand times ten thouſand; which is 100,000,000, viz. one hundred million: and a little farther you read of another, conſiſting of two hundred thouſand thouſand, which is, 200,000,000, viz. two hundred million, which you will ſee demonſtrated, Example the 3d and 4th, in compendiums of multiplication.

I ſhall finiſh Numeration with ſome of the old Roman numbers, as it may be of ſervice.

A TABLE *of* Old ROMAN Numbers.

L. ſignifies or ſtands for (50) fifty.
C. for (100) hundred.
CC. (200) two hundred.
CCC. (300) three hundred.
CCCC. (400) four hundred.
D. ſignifies (500) five hundred, or thus IↃ.
DC. ſtands for (600) ſix hundred, or thus IↃC.
DCC. (700) ſeven hundred, or thus IↃCC.
DCCC. (800) eight hundred, or thus IↃCCC.
DCCCC. (900) nine hundred, or thus IↃCCCC.
M. (1000) a thouſand, or thus CIↃ.
MM. (2000) two thouſand, &c.

ROMAN Numbers explained by FIGURES.

DL. 550.
DCCX. 710.
MDXIV. 1514.
MDCLI. 1651.
MDCCIX. 1709.
MDCCLXXXVII. 1787, &c.

And now, *Tyro*, we will proceed to addition.

SECTION II.

Of ADDITION.

Tyro. WHAT do you mean by Addition?

Philo. Addition ſignifies the gathering, collecting, and adding together, two or more numbers into one ſum.

Tyro. How many parts are there in Addition?

Philo. Two, ſimple and compound.

Tyro. What is ſimple Addition?

Philo. Simple Addition is that which conſiſts of one ſimple or ſingle name; that is to ſay, of whole numbers only, as pounds ſterling, tons, yards, ells, or ounces, &c. For ten is ten, and a thouſand is a thouſand, in any number and quantity; though the quality or name be different; and they are all added by one rule, namely, by caſting out the tens, and ſetting down in every line what is over ten, as you will ſee by and by.

Tyro. What does compound addition conſiſt of?

Philo. Of money, weights, and meaſures, viz. Avoirdupoiſe Weight, Troy Weight, Apothecaries, and Goldſmith's Weight, &c. Likewiſe, Dry Meaſure, Liquid Meaſure, Cloth Meaſure, Square Meaſure, Long Meaſure, Land Meaſure, and Time. Of theſe in their order.

SECTION III.

ADDITION of WHOLE NUMBERS.

THE rule to be got by heart is,

For every ten in the units place, or firſt row of figures, you muſt carry one to the tens place, or ſecond row, and ſo proceed; becauſe ten units make ten, ten tens an hundred, and ten hundred a thouſand.

Add	2	3	2		9	
	1	2	1		7	
	1	1	4		8	
	5	2	3	and	4	together.
	9 *Anſ.*	8 *Anſ.*	10 *Anſ.*		28 *Anſ.*	

Here I ſay, 5 and 1 is 6, and 1 is 7, and 2 is 9; which I place under the numbers, and it is done: but to prove whether it be right, I begin at top, and caſt it downwards, and find it comes to the ſame.

Secondly, If it amounts to juſt ten and no more, (as in Example 3) ſet it down, as before; only ſet the cypher under the row, and ſet the figure of 1 out towards the left hand. So alſo, in Example 4, I find it amounts to 28, which I ſet under the row, viz. the units 8 under the row itſelf, and the 2 towards the left hand in the place of tens.

Thirdly, When you have two or three rows of figures, then, according to the rule, add up the firſt row, or units place, and obſerve how many tens it contains, and if it comes juſt to even tens, ſet a cypher underneath, and carry as many ones to the next row, as there were tens in it; that is, if it be 20, carry 2, if it be 30, carry 3, if 40 carry 4, and for 50 carry 5, &c. And the laſt row of all ſet down what it amounts to, as if it were one ſingle row only.

An EXAMPLE at large.

Add 87625 pounds
94915
62194
76547
81965
92198
and 71964 together

567408 *Anſ.*

Now obſerve once for all. I begin and ſay, 4 and 8 is 12, and 5 is 17, and 7 is 24, and 4 is 28, and 5 is 33, and 5 is 38; this is the amount of the firſt row, or units place, but I muſt not ſet down the whole 38, but ſee how many tens it contains, and find it to be 3 tens and 8 over; this 8 I ſet under the row, and carry 3 to the next row, or tens place, ſaying, 3 that I carry and 6 is 9, and 9 is 18, and 6 is 24, and 4 is 28, and 9 is 37, and 1 is 38 and 2 is 40: this being juſt 4 tens, I ſet down a cypher, and carry 4 for the 4 tens to the next row, or hundreds place, ſaying, 4 and 9 is

13, &c. and I find the third row to be 44, which is 4 tens and 4 over; therefore I ſet down 4, and carry 4 to the fourth row, or place of thouſands, and find that it amounts to 27, then I ſet down the odd 7, and carry 2 to the 5th or laſt row, and find that it amounts to 56, and becauſe this is the laſt row, I ſet down the whole 56, that is, the 6 under the row, and the 5 to the left-hand.

Fourthly, When there are ſeveral numbers to be added together, conſiſting of ſome fewer and ſome of more figures, they are added after the ſame manner as before, only obſerve, in ſetting down the numbers on your-ſlate, or in a book, that you be careful to ſet units under units, tens under tens, or elſe you will be puzzled in caſting them up.

Ex. 6. Suppoſe I were to add 3417, 26, 184, 9, 271, and 3 together: I ſet them down as follows, which will be a ſtanding rule for any thing of the like nature.

EXAMPLE 6.

```
Loads.
 3417
   26
  184
    9
  271
    3
 ————
 3910
```

Here you ſee I ſet units under units, and tens under tens, and then I caſt them up from row to row as before directed.

Tyro. I underſtand it very well; but I ſhould have ſet it down thus, with cyphers, to ſupply the vacant places:

```
3417
0026
0184
0009
0271
0003
————
3910
```

Philo. It is quite ſuperfluous; for you have been told already, that cyphers before figures do not at all increaſe the value; beſides they are neither ſo ſightly, nor advantageous to caſt up, nor are they ſeldom or ever uſed by accomptants, even in addition of money, to fill up any line or ſpace whatſoever, as you will ſee in example 13, of *Addition of Money.*

More Examples in whole Numbers.

Buſhels.	*Ells.*	*Yards.*
471756	6715	65432
434176	46	2145
621985	2	234
942176	2176	67
354219	200	8
471625	6	76
982196	10	354
853294	1756	3256
	1	76258
5131427	10912	147830

And now, *Tyro*, I will ſet you two or three queſtions by way of exerciſe.

Queſtions to exerciſe Addition of Whole Numbers.

Queſt. 1. From *London* to *Rumford* is 11 miles, from *Rumford* to *Brentwood* 6, from *Brentwood* to *Chelmsford* 11, from *Chelmsford* to *Witham* 8, from *Witham* to *Kelvedon* 4, from *Kelvedon* to *Colcheſter* 10, from *Colcheſter* to *Manningtree* 9, and from *Manningtree* to *Harwich* 12; how many miles then is it from *London* to *Harwich?* *Anſwer* 71.

Tyro. I apprehend the queſtion; it is only ſetting down the numbers as they ſtand in their order, as under.

	Miles.
From *London* to *Rumford*	11
From *Rumford* to *Brentwood*	6
From *Brentwood* to *Chelmsford*	11
From *Chelmsford* to *Witham*	8
From *Witham* to *Kelvedon*	4
From *Kelvedon* to *Colcheſter*	10
From *Colcheſter* to *Manningtree*	9
From *Manningtree* to *Harwich*	12
From *London* to *Harwich*	71 *Anſ.*

Queſt. 2. A farmer has ſeven fields, containing the following acres, *viz.*

	Acres.
In one field are	25
In another	57
In another	18
In another	25
In another	15
In another	43
In another	9

How many acres are there in all? *Anſ.* 192.

Anſ. 192 acres.

Queſt. 3. A draper has 6 pieces of cloth as under.

			Yards.
* N°	1	containing	87
	2	———	45
	3	———	17
	4	———	8
	5	———	32
	6	———	21

How many yards are there in all? *Anſ.* 210.

Anſ. 210 yards.

Queſt. 4. How many days are there in the year, or in the 12 calendar months? Firſt ſet them down as follows:

				Days.
1ſt,	*January* has		—	31
	February	—	—	28
	March	—	—	31
	April	—	—	30
	May	—	—	31
	June	—	—	30
	July	—	—	31
	Auguſt	—	—	31
	September	—	—	30
	October	—	—	31
	November	—	—	30
	December	—	—	31

Note, Every fourth year is called *leap year*, and has 366 days; *February* having then 29 days.

Anſ. 365 days.

---

* *Note*, That in marking any ſort of goods, N° ſtands for Number.

Queſt. 5. How far is it from *London* to *Carliſle* in *Cumberland*, when

From *London* to *Newcaſtle*, is	149
From *Newcaſtle* to *Preſton*	62
From *Preſton* to *Lancaſter*	21
From *Lancaſter* to *Penrith*	50
From *Penrith* to *Carliſle*	19
Anſ.	301

Tyro. I underſtand what you have ſhewn me very well.

Philo. Then I ſhall only leave one queſtion more for you to try at your leiſure.

Add 47, 697, 5, 91707, 100000, 26300175, 500, 62, and 987654321 together? *Anſ.* 1014147514.

To prove ADDITION.

Tyro. How do you prove *Addition?*

Philo. Two ways. *Firſt*, When you have caſt up any ſum, as before directed, then begin at the top and caſt downwards inſtead of upwards; and if the figures come the ſame, no doubt but the work is right; beſides in things which require care, you ſhould make a practice of caſting every line, firſt upwards and then downwards.

The *ſecond* way is very well for learners, but too tedious for buſineſs; but as it is cuſtomary in ſchools to teach it, I ſhall ſhew you the method, which is as follows.

Let us take *Queſt.* 5, which amounts to 301 miles; and to prove whether this be right, I cut off the top line of figures by a ſtroke of the pen, thus——

149
62
21
50
19
301 *Anſ.*
152 Add this to the top 149.
301 *Proof.* See *Addition of Money.*

Then I begin to caſt the ſum up again, as I did at firſt, (except the figures that are cut off, or that ſtand above the line, and find it amounts to 12, which is 2, and I carry 1; then I proceed to the ſecond row, and find it makes 15, ſo that this amounts in all to 152, which I place under the 301. *Laſtly*, I add this middle line 152 to the top line 149, and find that they make 301, which proves the firſt work to be right. I ſhall give you a further reaſon, when you come to examples of *Money*, why this way is not ſo fit for practice in buſineſs as caſting the ſum upward and downward. And now we will proceed to.

SECTION IV.

ADDITION *of* MONEY.

Tyro. WHAT is neceſſary to the learning of *Addition of Money?*

Philo. Theſe three things; *Firſt*, the rule; then the characters; and, *thirdly*, pence-tables; all which ſhould be perfectly got by heart before you pretend to caſt up money.

1. *The* RULE.

For every 4 farthings carry 1 penny to the pence; for every 12 pence carry 1 ſhilling to the ſhillings, and for every 20 in the ſhillings carry 1 to the pounds, which are caſt up by tens, as in whole numbers.

2. *Of the common* CHARACTERS.

Note 1. £ ſtands for pounds, *S* ſtands for ſhillings, *D* ſtands for pence. Or thus, £. *s.* *d.* pounds, ſhillings, pence.

Note 2. A farthing is one-fourth part of a penny, and is thus ſet down $\frac{1}{4}$. An halfpenny is one-half, and is thus ſet down $\frac{1}{2}$. Three-farthings being three-fourths, is thus ſet down $\frac{3}{4}$.

Note 3. 1 quarter, 1 half, and 3 quarters, are alſo ſet thus, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$.

3. *Of*

3. *Of* PENCE-TABLES.

TABLE 1.

Pence		s.	d.
20	is	1	8
30		2	6
40		3	4
50		4	2
60		5	0
70		5	10
80		6	8
90		7	6
100		8	4
110		9	2
120		10	0

TABLE 2.

Pence		s.
12	is	1
24		2
36		3
48		4
60		5
72		6
84		7
96		8
108		9
120		10

By the help of theſe two tables, the firſt increaſing by tens, or every 10 pence; and the other by even ſhillings, or every 12 pence, you will ſoon caſt up any ſmall ſums, by a due regard to the following examples.

Tyro. But I hope, ſir, you will give me an example in length, by explaining it in words; for that will be of more ſervice to me than an hundred examples without explanation.

EXAMPLE 1.

	£.	s.	d.	
Add	9	4	2	
	8	5	3	
and	7	9	6	together.
	24	18	11	

EXAMPLE 2.

	£.	s.	d.	
Add	41	3	8	
	62	9	7	
and	47	11	6	together.
	151	4	9	

EXAMPLE 3.

	£.	s.	d.	
Add	95	16	2	
	68	14	10	
and	49	12	11	together.
			*	

---

* I leave example 3 undone for your practice, and will give you another table for the more eaſily caſting up the ſhillings.

Philo. You ſeem to be timorous, and doubt your own abilities without occaſion. Come pray try at the firſt ſum.

Tyro. I ſee plainly how you do *that*, becauſe the pence all added together do not exceed 12, nor do the ſhillings exceed 20; therefore I ſet the amount of them under the row to which they belong, and find the total to be twenty-four pounds, eighteen ſhillings, and eleven pence.

Philo. The ſame is to be obſerved in example 2. Thus I ſay, 6 and 7 is 13, and 8 is 21 pence. Now, by the firſt table, 20 pence is 1*s.* 8*d.* therefore, 21 pence muſt be 1*s.* 9*d.* Or, by the 2d table, I aſk how many times 12 I can have in 21*d.* and find it 1, and 9 over; therefore, I ſet the odd 9 down under the place of pence, and carry 1 to the ſhillings, ſaying, 1 that I carry and 11 is 12, and 9 is 21, and 3 is 24 ſhillings. Now, as 20*s.* make a pound, 24*s.* is 1*l.* 4*s.* therefore I ſet the 4 under the ſhillings, and carry 1 to the firſt row of the pounds, caſting them up as in *Addition of whole Numbers*, and find it 151*l.* ſo is the total 151*l.* 4*s.* 9*d.*

TABLE 3.

Shillings.		*Pounds.*	*s.*
20		1 -	
30		1 -	10
40		2 -	
50		2 -	10
60	is	3 -	
70		3 -	10
80		4 -	
90		4 -	10
100		5 -	

Pleaſe to add up the following ſums.

EXAMPLE 4.

£.	s.	d.
45	9	9
94	5	8
76	7	10
51	8	9
25	7	6
75	5	11
368	5	5

EXAMPLE 5.

£.	s.	d.
249	3	10
176	5	8
649	8	6
148	7	5
219	5	7
154	7	9

EXAMPLE 6.

£.	s.	d.
652	5	8
652	5	8
652	5	8
652	5	8
652	5	8
652	5	8

Tyro. I begin at the row of pence, and find that it amounts to 53. Now, according to my *firſt pence-table*, 50 pence is 4*s.* 2*d.* therefore 53 pence is 4*s.* 5*d.* Or, by *table* 2, I find how many 12 pences I can have in 53 pence, and find that 4 ſhillings is 48 pence, therefore 53 pence muſt be 4*s.* 5*d.* which odd 5 pence I ſet down under the row of pence, and carry the 4 ſhillings to the row of ſhillings, and find it amounts to 45. Now, by *table* 3, I find 45*s.* to be 2*l.* 5*s.* which odd 5*s.* I put under the ſhillings, and carry 2*l.* to the pounds, which I caſt up as in *whole numbers*, (by tens) and find the *total*, or whole amount, to be 368*l.* 5*s.* 5*d.*

Philo. Very well; but now you have done it, pray let me hear you ſay what it comes to; for I have known many ſchool-boys not able to read what they write or caſt up.

Tyro. 'Tis very true, ſir, but I think it is three hundred and ſixty-eight pounds, five ſhillings, and five pence.

Philo. Very right, and I make no doubt, by your careful proceeding, but you will underſtand the firſt four rules of *Arithmetic* in a ſhort time. I leave example 5 and 6 undone, for you to try at your leiſure, after the ſame way and manner; and now I will try you with an example or two with farthings.

EXAMPLE 7. £.	s.	d.	EXAMPLE 8. £.	s.	d.	EXAMPLE 9. £.	s.	d.
47	8	4½	271	7	6¼	278	4	3
15	5	10	146	5	8¼	164	8	9½
17	4	8½	956	8	3	215	1	10
49	9	6¼	178	7	8¾	464	5	4¼
15	10	7	246	9	7¼	176	7	8½
14	7	9¾	101	6	5	291	3	5
97	3	5¾	247	8	3½	456	7	6¾
14	9	6	604	9	8¾	278	5	7
Anſ. 270	19	9¾						

Tyro. I can do theſe as well as the other. *Firſt*, I begin with the farthings, ſaying, 3 and 3 is 6, and 1 is 7, and 2 is 9, and 2 is 11 farthings, that is 2*d.* and 3 farthings over, which 3 farthings I ſet under the row of farthings (thus ¾) and carry 2*d.* to the pence, and find they amount to 57 pence, which is 4*s.* 9*d.* this odd 9 I ſet under the pence, and carry 4 to the ſhillings, and find them 59, that is 2 pounds, and 19 over, which 19 I ſet under the ſhillings, and carry 2 to the pounds, I find them come to 270: ſo is the total or anſwer 270*l.* 19*s.* 9*d.* ¾.

Philo. Very well done, indeed: proceed in the ſame manner, and you will find *Ex.* 8, to be 2752*l.* 3*s.* 3*d.* ¼.

Tyro. I am obliged to you, ſir, and now I ſhould be glad you would give me inſtructions how you manage *double figures* in the ſhillings.

Philo. I will ſhew you three or four different ways, and you may take that which appears moſt natural and eaſy.

4. *Of caſting up* double figures *in the ſhillings, ſuch as* 16, 17, 18, *or the like.*

EXAMPLE 10. £.	s.	d.	EXAMPLE 11. £.	s.	d.	EXAMPLE 12. £.	s.	d.
64	17	10¼	756	17	8	4715	11	10½
47	14	11	175	16	11¼	1762	14	5
67	18	10¾	476	11	9½	6471	14	6¾
55	17	8½	187	17	10	1754	15	11¼
49	19	11	356	19	5¾	6474	19	8
64	15	5	175	14	11¼	1762	17	6
351	4	8½						

METHOD 1. I caſt the farthings up (firſt upwards and then downwards) and find them 6, I therefore ſet down ½, and carry 1 to the pence, which are 56, which is 4*s.* 8*d.* that is 8, and I carry 4 to the ſhillings; but as there are two rows of ſhillings, or *double figures*, I firſt of all caſt up that row, or thoſe figures that ſtand towards the right hand, ſaying thus, 4 that I carry and 5 is 9, and 9 is 18, and 7 is 25, and 8 is 33, and 4 is 37, and 7 is 44, the firſt row; then I come back upon the ſecond row, from the top to the bottom, calling every figure of 1, ten; ſaying, 44 and 10 is 54, and 10 is 64, (and ſo on) 74, 84, 94, and 10 is 104 ſhillings, which is 5*l.* and 4 ſhillings over, that is 4, and I carry 5 to the pounds, which I find amount to 351. So that the total is 351*l.* 4*s.* 8*d.* ½.

METHOD 2. Some like *this* way beſt; they caſt up the firſt row of ſhillings as before, which comes to 44, that is 2*l.* 4*s.* and ſet the 4 ſhillings under the ſaid row, and carry the 2*l.* to the next row of ſhillings, counting 1*l.* for every two figures in the ſecond row, (becauſe two tens make 20*s.* or 1*l.*) thus in the above example, there are ſix figures of 1 in the ſecond row, and counting two of them for 1*l.* then ſix will be 3*l.* which with the 2*l.* that belonged to the 44 in the firſt row, make 5*l.* to be carried to the pounds, as before.

METHOD 3. Others make uſe of *dots*: that is, they make a dot at every 4 in the farthings, every 12 in the pence, every 20 in the ſhillings, and every 10 in the pounds, which method is very eaſy, and ſuitable to lads of a dull comprehenſion, and a bad memory; becauſe they are not able to carry a large number of pence and ſhillings in their mind, but frequently carry falſe from figure to figure.

Note, There are different opinions concerning pointing or dotting: Mr. *Dilworth* highly recommends it; but Mr. *Fiſher* calls it ſlovenly and unneceſſary. It is not my province to determine between thoſe gentlemen: But this I will ſay, that every maſter ſhould try all methods, and let the ſcholar uſe *that* which is moſt natural and eaſy to his capacity. He muſt be very dull who can't tell that 2 tens make 20, or that 13 twenties make 260: and to ſtop or point at ſo ſmall numbers, as 3, 4, 5, 6, *&c.* ought (if poſſible) to be avoided; becauſe to add up well, and learn to caſt out quick, is a great ſtep towards *Multiplication*, and it would look very odd to ſee a perſon, (after having done a long ſum in that rule) dot every 10 in caſting up the product. I think therefore there is no occaſion to point or dot at every 4, 10, 11, or at even twenties, when a little practice will make it eaſy: but indeed when you come to do by 13, 16, 19, 28, or the like, there dotting muſt unavoidably be uſed, as you will ſee in the firſt example of *Avoirdupoiſe Weight*, wrought at large.

N. B. *If you are obliged to uſe dots, mind and make them very ſmall; if you can ſee them yourſelf, that is ſufficient: but the firſt method, in my opinion, is beſt, except it be a very long ſum, ſuch as the ſide of a large book, a* bill, *or a* pariſh rate, *or* duplicate, *and then the following method is the moſt certain and expeditious, and is very eaſy.*

METHOD 4. *Of making and caſting up long bills*, PARISH RATES, *&c.*

Tyro. How is the general way of caſting up very long bills, rates, *&c.*

Philo. The rule is this: *for every* 60 *in the pence carry* 5 *to the ſhillings*, becauſe 60 pence make 5 ſhillings: and *for every* 60 *in the ſhillings carry* 3 *to the pounds*, becauſe 60 ſhillings make 3 pounds; and *laſtly, caſt the pounds up by tens, as before directed.*

Tyro. Pleaſe to give me an example at large.

Philo. I will ſhew you firſt how to make a *pariſh-rate*, which may be of ſervice, and if you can caſt it up well, you may alſo caſt up any long bill, by the ſame rule.

The Form of a PARISH RATE, *&c.*

Allen Anthony, *Eſq.*	3	7	8 ¼
Andrews John	1	14	7 ½
Baker James, *Eſq.*	15	16	8
Carter Thomas		17.	11 ½
Darby Abraham	5	17	5
Fernel Abraham		19	8 ¾
Honner Joſeph	7		9.
Kirton John, *Eſq.*	21	14.	7 ¼
Longman Thomas	5		11 ½
Lumley Edward	3	17	6
Manning Thomas		15	10 ¼
Martin William, *Eſq.*	11	11	8 ½
Martin Job	7	17.	8
Nicholas Abraham	2	13	9
Norton Daniel, *Eſq.*	17	10	4. ½
Parker Eſther		8	11
Powell Judith		5	10
Randall Nicholas	1	17	6 ½
Robinſon Abraham, *Eſq.*	15	11.	11 ½
Robinſon John	7	10	
Robinſon James	1		10
Ruggles Nathaniel	7	11	4
Rumley Thomas		15	½
Solly Thomas, *Eſq.*	12	11	
Sorſby William		14.	
Spratly David	8		11.
Swallow Thomas	1	17	4
Thompſon John, *Eſq.*		19	11 ¾
Twiſt William, *Eſq.*	7	7	
Walker John	1	15.	6
Wayland Edward, *Eſq.*	8	14	9 ½
Wingate Samuel		15	7
Worley Abraham	5	4	10
£.	189	19	7 ¾

Firſt, I begin with the row of farthings (as in the former queſtions) and find them amount to 27, which is 6 pence, and 3 farthings over: which 3 I ſet under the farthings thus (¾) and carry 6 to the pence.

Secondly, *for the* PENCE.

I ſay, 6 that I carry and 10 is 16, and 7 is 23, and 9 is 32, and 6 is 38, and 11 is 49, and 4 is 53, and 11 is 64: This being 4 above 60, I make a ſmall dot cloſe to the 11, and carry the 4 that is over to the next figure, ſaying, 4 that I carry and 4 is 8, and 10 is 18, and 11 is 29, and 6 is 35, and 10 is 45, and 11 is 56, and 4 is juſt 60; therefore as there is nothing over to carry to the next figure, I ſay 9 and 8 is 17, and 8 is 25, and 10 is 35, and 6 is 41, and 11 is 52, and 7 is 59, and 9 is 68; that is 8 above 60, therefore I make a dot, and carry 8 to the next figure, ſaying, 8 and 8 is 16, and 5 is 21, and 11 is 32, and 8 is 40, and 7 is 47, and 8 is 55: now 50 pence is 4*s.* 2*d.* therefore 55 pence is 4*s.* 7*d.* which odd 7 pence I ſet under the pence, and carry the 4 ſhillings to the dots, counting (as I ſaid before) 5 ſhillings for every dot, which are three in number, that is 15 ſhillings; and the 4 I carry to them is 19 ſhillings; this 19 I carry to the ſhillings, and contrary to the other methods, I now work croſs ways, taking the *double figures* as I go along, *viz.* the right-hand figure firſt, and then the left-hand one belonging to it, counting it for 10, as follows:

Thirdly, *for the* SHILLINGS.

I ſay, 19 that I carry and 4 is 23, and 5 is 28, and the 1 on the left hand of it, which is always counted for 10, is 38, and 4 is 42, and 10 on the left hand belonging to it is 52, and 5 is 57, and the 10 belonging is 67; here, according to the ſame rule, I make a dot, and carry the odd 7 to the next figure, as I did in the pence; ſaying, 7 that I carry and 7 is 14, and 9 is 23, and 10 is 33, and 7 is 40, and 10 is 50, and 4 is 54, and 10 is 64; that is dot and I carry 4, to 11 is 15, and 5 is 20, and 10 adjoining it is 30, and 11 is 41, and 10 is 51, and 11 is 62, which is dot and I carry 2 to the next figure, proceeding in the ſame manner as before directed till I come to the top of all, and find there are 39 ſhillings, beſides the laſt dot, that is 1£. 19*s.* therefore I ſet the 19 under the ſhillings, and carry the odd 1£. to the dots (counting 3£. for every dot, becauſe 60 ſhillings is 3£.) and find them 6, which is 18£. and 1 I carry to them is 19£. which I carry to the firſt row of the pounds, caſting them up by tens, as in *whole numbers*, and find them 189£. So that the total of the rate or bill is 189£. 19*s.* 7*d.* ¾. Pray, *Tyro*, run it over once more, and the method alſo, and you will not loſe your labour.

Tyro. Sir, I ſee the nature of it very well; but why do you leave thoſe vacancies in the ſhillings and pence, for moſt people fill them up with cyphers.

Philo. I know it is the common cuſtom of ſchools; but it is a very idle one, nor is it ſo ſightly or convenient; for the cyphers hinder ſight, and prevent expedition in caſting up. *See example* 6, *in whole numbers.*

5. *Of* CYPHERS, *where neceſſary, and where not.*

EXAMPLE 13, *without cyphers, according to the true Order of* BOOK-KEEPING.

£.	s.	d.
5478	9	6
1	19	5
	6	8¾
179		
	17	½
7	5	9
1	17	7
	4	½
5670		¾

EXAMPLE 13, *with cyphers, according to the common Cuſtom of* SCHOOLS.

£.	s.	d.
5478	09	06
0001	19	05
0000	06	08¾
0179	00	00
0000	17	00½
0007	05	09
0001	17	07
0000	04	00½
5670	00	00¾

Now, *Tyro*, I would aſk you which is moſt ſightly, *that* which ſtands clear, or the other confuſed with cyphers. And not only this, but every line of the ſum, and the total alſo, reads much better: for it is only five thouſand, ſix hundred, and ſeventy pounds, and three farthings; whereas the other (according to the manner of cyphers, and the too common cuſtom of ſchool-boys) muſt be thus read, *five thouſand, ſix hundred, and ſeventy pounds, no ſhillings, and no pence, three farthings.* And though cuſtom ſome years ago prevailed upon one of the moſt ingenious authors *, to uſe the *expreſſion* after this ſort, it is now quite ſuperfluous, and out of date.

Note, Though I ſay it be not cuſtomary to uſe cyphers in *addition of money,* yet in *weights* and *meaſures* they are often made uſe of, and the learner may take his own fancy that teaches himſelf: but it is my opinion that maſters in general would find it much eaſier and better, both to themſelves and ſcholars, to ſet their addition ſums quite clear, and uſe no cyphers at all before figures.

Tyro. I am obliged to you, ſir; and now, if you pleaſe, I would know how you prove *addition?*

Philo. That is quite eaſy, *Tyro.*

6. *To prove* ADDITION *of* MONEY.

There are two ways, one by cutting off the top line (of which ſee under the proof of *addition)* but it is not practicable in buſineſs; the beſt way is this: begin at the bottom, and caſt up to the top, noting down what it comes to; then begin at the top, and caſt the ſame row downwards, and if it amounts to the ſame as before, there is no doubt but the work is right, provided you obſerve carefully to ſet the total down right.

SECTION V.

Containing ſome farther explanation of things neceſſary to be known, with the manner of drawing out bills, *writing* notes *ond* receipts, *&c. being very proper to exerciſe the young beginner.*

Tyro. I Shall be at a loſs under this ſection.

Philo. You are miſtaken; for I ſhall not leave you to yourſelf wholly, but will explain every thing I am capable of, to your underſtanding; becauſe I am ſenſible many ſchool boys can add up ſums that are ſet them very well; but when they are called upon out of ſchool, to write out and caſt up a ſmall bill, or the like, how aukward do they go about it, and will ſit puzzling over it ſo long, that one would think they knew nothing at all of the matter: and when it is done, it is often ſet in ſuch confuſion, that it will puzzle much better ſcholars than themſelves to caſt it up; becauſe they do not obſerve to place their figures right under one another, which remember, *Tyro*, you be always careful of, for it is a great advantage, and the work will look neat, and you will have the praiſe.

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* *Wingate,* Page 8.

Tyro. 'Tis very true, ſir, I have known ſeveral that could caſt up a bill if others would figure it down, but have not had any notion of drawing it out themſelves: nor can I ſay I have, and therefore ſhould be obliged to you to ſhew me.

Philo. That I will; but firſt of all it will be proper to ſhew you ſome *ſigns* and *contractions* made uſe of both in arithmetic and buſineſs.

1. *Of contracted Signs and Characters uſed in common Arithmetic.*

Note 1. This character (+) ſignifies addition, and when placed betwixt numbers ſhews that they are all to be added together. Thus, 5 + 7 + 11 + 9, is thus read, 5 more 7, more 11, more 9, &c.

2. This character (—) ſignifies leſs, and is the ſign of ſubtraction, and ſhews the number after it is to be taken out of the number before it; thus, 11 — 7 is 11 leſs 7, which is 4; and 148 — 93 ſhews that 93 is to be ſubtracted from 148, &c.

3. This (×) is the ſign of multiplication, and ſignifies into, and ſhews that all the numbers betwixt which it is placed are to be multiplied continually into each other. Thus, 4×5×3, ſhews that 4 is to be multiplied into or by 5, and that product by 3.

4. This (÷) is the ſign of diviſion, and ſhews the number before it is to be divided by the number after it. Thus 48 ÷ 6 ſhews that 48 is to be divided by 6.

5. This (:) ſignifies to.

6. This (::) ſignifies ſo is.

7. The two laſt characters put together thus (: :: :) are the ſign of the rule of 3 or proportion. Suppoſe you ſee 2 : 4 :: 8 : 16; it is thus read, as 2 to 4, ſo is 8 to 16, &c. As $a : b :: c : d$. As a to b, ſo is c to d, &c.

8. This (=) is the ſign of equality, and ſignifies that the figures or quantities placed before it are *equal to* thoſe after it; thus $4+12=16$, is read 4 *more* 12 *equal to* 16. So alſo $25-16=9$, is 25 *leſs* 16, or 16 *ſubtracted from* 25 *equal to* 9. So alſo $5 \times 9 + 12 - 2 \div 5 = 11$, is thus read; 5 *into* 9, *more* 12, *leſs* 2, *divided by* 5, *is equal to* 11.

9. This ($\surd$) is the ſign of the ſquare root.

10. This ($\sqrt[3]{}$) the ſign of the cube root.

2. *Of contracted Words, and what they ſignify.*

Note 1. *Bt.* ſtands for, or ſignifies *bought*.

2. *Dr.* is *Debtor*. *Cr.* is *creditor*.

3. *Do.* ſtands for *ditto*, and ſignifies the ſame thing, place, or ſort of goods, as was wrote in the line before; it is uſed by merchants, tradeſmen, and accomptants, both in books and bills, to avoid writing the ſame thing over and over again.

4. *Co.* ſignifies *company*; that is, when two or more are in trade and in partnerſhip.

5. *Meſſrs.* ſignifies *Meſſieurs*, or gentlemen concerned together in ſome trade or buſineſs, and is uſed with the foregoing contraction (*Co.*) on the head or front of the bills, inſtead of writing all their names at length; thus, ſuppoſe *John Sharp* to have a bill upon *Aaron Nelſon*, *John Long*, and *Joſeph Truman*, it would be ridiculous to write thus:

Mr. *Aaron Nelſon*, Mr. *John Long*, and Mr. *Joſeph Truman*, bought of *John Sharp*.—But we write thus:

Meſſrs. *Aaron Nelſon* and *Co.* bt. of *John Sharp*, as you will ſee in the following example.

A Linen-Draper's Bill.

EXAMPLE 1.

Meſſrs. *Aaron Nelſon* and *Co.* bt. of *John Sharp.*

			£.	s.	d.
1786.					
Jan.	4.	To 11 pieces of Iriſh at 3*l.* *per* piece ——	33		
	12.	To 2 ditto, at do. ——	6		
Feb.	8.	To long lawn as by agreement	3	15	6
Apr.	12.	To 2 pieces of check, as by do.	1	7	10
	28.	To 4 do. as by do. ——	2	2	
May	24.	To 2 yards of dowlas, at 11*d.*		1	10
Aug.	9.	To a parcel, as *per* bill —	1	15	6
		This bill I caſt up as a common ſum in *Addition of Money*, and find the total	48	2	8

EXAMPLE 2.

A Stationer's Bill.

Mr. *Samuel Long* bt. of *John Page.*

			£.	s.	d.
1786.					
May	19.	2 Ream of fool's-cap ſuperfine paper — ——	1	10	
June	12.	4 Ditto —— —	3		
		20 Ream of coarſe brown —	1	10	6
Aug.	14.	To ſundry goods, as *per* bill	3	19	6
			£.10		

Note, Some perſons never uſe the word *To* at the beginning of the bill. *Note* farther, the word *To* is uſed in books of accompts on the *Dr.* or left-hand ſide. The word *By* is uſed on the *Cr.* or right-hand ſide.

And now, *Tyro*, I ſhall draw you out a few more bills, and leave you to ſet them on a ſlate, and caſt them up yourſelf, which will be of ſervice, by way of exerciſe.

EXAMPLE 3.

A Goldſmith's Bill.

Mr. *James Proud* bt. of *Paul Fineſhew.*

1786.		£.	s.	d.
May 9.	To 1 Diamond ring ———	15	-	-
	2 Pair of ſilver ſalts ———	2	2	6
	1 Quart tankard ———	10	10	-
	1 Pint do. —— ———	4	7	6
	1 Dozen of knives and forks —	3	2	6
	1 Silver tea-kettle ———	5	5	-
	12 Tea-ſpoons, tongs, and cream-pot	1	15	-
	Total £.			

EXAMPLE 4.

A Taylor's Bill.

Mr. *Robert Patience* Dr. to *John Trimmer.*

1786.		£.	s.	d.
Mar. 15.	To 2 Yards of cloth, at 18*s.* per yard ——— —	1	16	
	Making your coat ——	-	8	-
	4 Yards and a half of ſhalloon, at 2*s.*	-	9	-
	Buckram, ſtay-tape, and canvas	-	3	6
	Silk, twiſt, and mohair ——	-	2	8
	Making a ſuit for your ſon	-	5	9
	Buckram, ſilk, twiſt, mohair, &c.	-	4	3
	Buttons to the ſame ——	-	3	6
	£.			

Now, from theſe four examples, *Tyro*, you may form any other tradeſman's bill in due order; and as for making out or balancing any reckoning between one perſon and another, to ſee how much is due to either, that is not the work of *Addition*; but I ſhall explain it very fully to you in *Subtraction*.

2. *The manner or common Form of* Receipts, *and* Notes of Hand.

Tyro. How am I to give or write a *receipt?*

Philo. According to what money you receive, and the perſons you receive it of, or for. Let us take the

ſta

ſtationer's bill in example 2, which is 10*l.* Now, if he receives it in full, the receipt will run thus:

Auguſt 16, 1786. *Received of Mr.* Samuel Long *ten pounds in full.*

John Page.

£. 10

If the receipt be wrote upon the bill itſelf, then this is better:

Received at the ſame time the contents in full.

John Page.

EXAMPLE 2. If only part be received, then thus:

Auguſt 16, 1786. *Received of Mr.* Samuel Long *five pounds on accompt.*

John Page.

£. 5

EXAMPLE 3. If the perſon that receives the money be a ſon or ſervant, he muſt write thus:

Auguſt 16, 1786. *Received of Mr.* Samuel Long *ten pounds in full, for my father (or maſter.)*

John Page, *jun.*

EXAMPLE 4. For Rent.

June 14, 1786. *Received of Mr.* John Lumley *twelve pounds, ten ſhillings, for half a year's rent, due at* Lady-Day *laſt.*

Abraham Gripe.

£. 12 - 10

EXAMPLE 5. When there has been an account of long ſtanding, and at laſt the two parties agree to have a reckoning, but ſtill he that owes money upon the balance has none at that time to pay, then the following form is counted better than a common note of hand, becauſe it ſhews the reaſon of ſuch an acknowledgment: but then this writing ſhould be drawn in the book of the perſon to whom the balance is due, and if ſigned in the preſence of witneſſes the better.—The form is thus:

Auguſt 16, 1786. *Reckoned and balanced all accounts, and I* Samuel Long *acknowledge myſelf to be indebted to* John Page *three pounds, ten ſhillings, which I promiſe to pay on demand, for value received. Witneſs my hand,*
Teſt. Samuel Long.
Abraham Juſtice.

EXAMPLE 6. When a perſon has no money about him, or has his money in other perſons hands, and gives you a note or draught upon them for the payment of any ſum, it is wrote after this manner:

Sir, pleaſe to pay to Mr. John Page, *or bearer, three pounds, ten ſhillings, and place it to the account of*
Your humble ſervant,
To Mr. Jonathan Truſty. Samuel Long.

3. *Of the Value of the common Coins uſed in* England, *how they are expreſſed, and how ſet down.*

A *Port*, or *Portugal* piece, is ſet down 1*l.* 16*s.* but is expreſſed, or commonly called a ſix and thirty.

A double *Port* is 3*l.* 12*s.*

A *Moidore* is ſet down 1*l.* 7*s.* but is called a ſeven and twenty.

A *Guinea* is 1*l.* 1*s.* and expreſſed a guinea.

A *Crown* is expreſſed a crown; but ſet down 5*s.*

Half a Crown is 2*s.* 6*d.*

A *Teſter* is ſix-pence.

A *Groat* is four-pence.

An uſeful EXAMPLE.

A ſervant laid out caſh as follows: for *coals* a guinea and a half. *Cloth* three and twenty and ſix-pence. *Meat* ſeven groats. *Butter, eggs,* and *bacon,* nineteen-pence half-penny; and *thread* ſeven farthings. What was laid out in all?

Tyro. I ſet them down as follows:

	£.	s.	d.
For coals	1	11	6
Cloth	1	3	6
Meat		2	4
Butter, eggs, and bacon		1	7½
Thread			1¾
In all	2	19	1¼

Philo. Very well done indeed. *Obſerve farther then,* that from *one* to *two* ſhillings, and from *one* to *two* pounds, the *expreſſion* is different from the *ſetting down.* Thus 1*s.* 10*d.* ½ is expreſſed two and twenty-pence halfpenny; and 1*l.* 19*s.* 6*d.* is expreſſed nine and thirty and ſix-pence.

So alſo, though theſe numbers, 1300, 1753, and 2500, are properly, one thouſand three hundred, one thouſand ſeven hundred and fifty-three, and two thouſand five hundred; yet they are thus expreſſed, thirteen hundred, ſeventeen hundred and fifty-three, and five and twenty hundred.

Tyro. I heartily thank you, kind ſir, and if it were not too troubleſome, I could wiſh you would ſet me a few queſtions by way of exerciſe.

Philo. You do very well to aſk me, *Tyro*; but it will be better at the end of *Addition*, where I ſhall give you ſome uſeful examples.

SECTION VI.

AVOIRDUPOIS WEIGHT.

Tyro. PRAY what is the uſe of this rule, or what are weighed by it?

Philo. Moſt things that are commonly dealt in, ſuch as *grocery wares*, and alſo *cheeſe*, *butter*, *ſoap*, *candles*, *allum*, *braſs*, *iron*, *copper*, *ſalt*, *hemp*, and all ſuch ſort of goods.

Tyro. What are the different names or denominations of the weights uſed in this rule?

Philo. The *greateſt* denomination is a *ton*, and the *leaſt* a *dram.* They run thus in order: *tons*, *hundreds*, *quarters*, *pounds*, *ounces*, and *drams*; of which is compoſed the following table, with the characters that ſtand for each denomination after them.

The TABLE.

16 Drams	make	1 Ounce, marked thus	*oz.*
16 Ounces		1 Pound	*lb.*
28 Pounds		1 Quarter of an hundred	*qr.*
4 Quarters		1 Hundred weight	*Ct.*
20 Hundreds		1 Ton	*T.*

Tyro. Should I get this table by heart?

Philo. You may do as you pleaſe; I know ſome maſters call it unneceſſary; but if you take my advice, learn every table perfectly. 'Tis true, you may do the ſums without it, if you have the table before you, but it would be a very bad thing to make an excuſe, by ſaying you could do ſuch a ſum if you knew the rule by heart; and I have known many a lad lament the omiſſion.

Tyro. I don't doubt it at all, and I will take your advice: pleaſe to tell me how to caſt up thoſe ſums.

Philo. The ſame as in *Addition of Money*, only you ſtop (as is plain by the table) by different figures; and for your further information, I ſhall put over every row and denomination, the quantity you are to ſtop at, or do by, and ſhall give you one example at large as a ſtanding rule for all that follows:

EXAMPLE 1.

(10) *Tons*	(20) *C.*	(4) *qrs.*	(28) *lb.*
25	14	1	15.
18	11	2	16
27	17	3	21.
46	14	1	17.
16	17	2	15
45	15	1	17.
16	17	3	14
198	9	1	3

EXAMPLE 2.

(10) *C.*	(4) *qrs.*	(28) *lb.*	(16) *oz.*
42	1	17	10
17	2	19	14
21	3	22	11
17	2	17	12
24	1	22	15
65	3	17	13
24	1	21	10

I begin at the *lbs.* and ſay, 14 and 7 is 21, and the 1 on the left hand (which is always called 10) is 31, that is 3 above 28; therefore I make a dot againſt the 7, and carry the odd 3 forward; ſaying, 3 that I carry and 5 is 8, and 10 on the left of it is 18, and 7 is 25, and 10 on the left is 35, that is 7 above 28; then I dot again, and carry 7 to the next figure, ſaying 7 and 1 is 8, and 2 on the left hand, which ſtands for 20, is 28; therefore, as there is nothing over, I only ſay 16 and 5 is 21, and 10 is 31, that is 3 above 28, which 3 I place under the row of pounds, and then telling my dots, I find them 4 (that is 4 qrs.) which I carry to the next row of qrs. ſaying 4 and 3 is 7, and 1 is 8, and 2 is 10, and 1 is 11, and 3 is 14, and 2 is 16, and 1 is 17 quarters. Now, as 4 quarters make an hundred, I aſk how many *fours* I can have in 17, and find 4 *fours*, and 1 over, that is 4 hundred, 1 quarter, which one I place under the row of quarters, and carry the 4 to the hundreds, which I caſt up by *twenty*, the ſame as in *Addition of Money*, ſaying 4 that I carry and 7 is 11, and 5 is 16, and 7 is 23, and 4 is 27, and 7 is 34, and 1 is 35, and 4 is 39; then I come back with the tens, ſaying 39 and 10 is 49, and 10 is 59, and ſo on, 69, 79, 89, 99, and 10 is 109, which is 5 twenties, and 9 over; that is, 5 tons, and 9 hundred over, which 9 I place under the hundreds, and carry 5 to the firſt row of the tons, and caſting them up as whole numbers by tens, I find the firſt row 48, that is 8, and I carry 4 to the next row, which amounts to 19. Therefore the total is 198 *tons*, 9 *c.* 1 *qr.* 3 *lb.*

☞ This is a ſtanding rule, *Tyro*, for all your other ſums in *Addition*, which are caſt up after the very ſame manner: thoſe that you find done, are for your information and ſatisfaction; and ſuch as are left undone, are for your practice. Are you ſatisfied with what I have told you?

Tyro. Sir, I am; but in example 2, I perceive you ſet 10 over the *hundreds* place, contrary to the table; whereas in example 1, you have ſet 20 over the *hundreds* place, which I own puzzles me at preſent.

Philo. That is for want of a little conſideration, *Tyro*; for whatever *name* or *denomination* ſtands firſt (that is, whatever you add up laſt) is always added up like *whole numbers*, by *tens*; be they *tons*, *hundreds*, *pounds*, *ſhillings*, *yards*, *ells*, or any thing elſe, as you will ſee hereafter.

Tyro. I am obliged to you, ſir, and deſire no further inſtruction in *Addition*, but only the rules and examples to go by.

Philo. You ſhall not want for either, and they are all done after the ſame manner as this example before you, though by different figures: and pray take *notice*, all thoſe examples that you find ready done, are not to indulge you in idleneſs; but the anſwers are inſerted for your information and ſatisfaction; and thoſe that are left undone are for your exerciſe, practice, and improvement; and though I told you in *Addition of Money* it is not cuſtomary to uſe cyphers; yet, if you chooſe it, take your own way; but you will find it better to leave them out, when there is no occaſion to uſe them.

AVOIRDUPOIS *ſmall Weight.*

Tyro. What is the uſe of this rule?

Philo. It is chiefly uſed by ſuch as deal in ſilk, worſted, thread, &c. by *retail*, or in ſmall quantities only; that is, from a dram to pounds: 16 drams make an ounce, and 16 ounces 1 pound.

EXAMPLE 1.

(10)	(16)	(16)
lb.	*oz.*	*dr.*
2 -	10. -	5
4 -	7 -	3
1 -	6 -	11.
6 -	9. -	0
3 -	7 -	9
18	8 -	12

EXAMPLE 2.

(10)	(16)	(4)
lb.	*oz.*	*qrs.*
3 -	14 -	2
1 -	11 -	1
3 -	09 -	0
2 -	01 -	2
2 -	00 -	3

Note, *Worſted* is weighed by ounces and quarters, as in *example* 2, and no drams are uſed here, nor in retailing many other commodities.

Of WOOL.

Wool is weighed by the *clove*, *ſtone*, *tod*, *wey*, &c. as follows:

7 Pounds make 1 clove
2 Cloves or 14*lb.* 1 ſtone
2 Stone, or 28*lb.* 1 tod
6 ½ Tod 1 wey
2 Weys 1 ſack
12 Sacks 1 laſt

Note, In ſome places 7 tod are allowed to 1 wey, and 12 ſcore, or 240*lb.* is called a *pack of wool.*

Note farther, A firkin of ſoap is 64 *lb.* a firkin of butter 56 *lb.* a clove of cheeſe 8 *lb.* a wey of cheeſe in *Eſſex* is 32 cloves, or 256 *lb.* a wey in ſome parts of *Suffolk* is the ſame; but in other parts of it, 42 cloves, or 336 *lb.* make a wey.

☞ See another table of *weights* and *meaſures*, *ſection* 6.

TROY-WEIGHT.

Tyro. Of what uſe is *Troy-Weight?*
Philo. By this is weighed gold, ſilver, jewels, electuaries, &c. and liquors in general.

TABLE.

24 Grains	make	1 Pennywt.	thus	*dw.*
20 Pennywts.		1 Ounce		*oz.*
12 Ounces		1 *lb. Troy*		*lb.*

Note, You need not *point* or *dot* at any row except the firſt, where you do by 24; the others are eaſy and common, as before, the pennyweights being caſt up by 20, are done the ſame as ſhillings; and the ounces being done by 12, are caſt up like pence, in *Addition of Money*.

(10)	(12)	(20)	(24)	(10)	(12)	(20)	(24)
lb.	*oz.*	*dw.*	*gr.*	*lb.*	*oz.*	*dw.*	*gr.*
42	11	14	18.	647	11	17	16
26	9	10	21	197	10	15	23
49	10	11	11.	494	11	19	14
65	8	14	12	165	9	15	21
73	9	15	16.	219	1	11	19
87	11	18	11	648	8	15	21
347	2	5	17				

Note 2. That 1*lb. avoirdupois-weight* is equal to about 14 ounces 12 pennyweights *troy*.

Note 3. Cuſtom only introduced *avoirdupois-weight* and *beer-meaſure*: for according to the ſtatute laws, there ſhould be but one *weight* and one *meaſure* throughout the whole realm, as you may ſee under *dry meaſure, Note* 1. Therefore, it is evident, that from theſe two different weights, came the different ſorts of meaſures, as you will more plainly ſee under *dry meaſure* and *liquid meaſure*.

Note farther, the Value of Gold *and* Silver.

	Gold.		£.	*s.*	*d.*
That	1 Pound weight of gold is worth		48	0	0
	1 Ounce	— —	4	0	0
	1 Pennyweight	— —	0	4	0
	1 Grain	— —	0	0	2
	Silver.				
That	1 Pound weight of ſilver is worth		3	0	0
	1 Ounce	— —	0	5	0
	1 Pennyweight	— —	0	0	3
	1 Grain about ½ a farthing.				

APOTHECARIES WEIGHT.

Tyro. What is the uſe of this weight?

Philo. By it *apothecaries* mix and compound their medicines, their pound being the ſame as the pound *troy*, only differently divided, as you ſee in the following table.

Note, Though *apothecaries* mix their medicines by this rule, they buy and ſell their drugs by *avoirdupois weight*.

The

The TABLE.

20 Grains	make	1 Scruple	℈ thus marked.
3 Scruples		1 Dram	ʒ
8 Drams		1 Ounce	℥
12 Ounces		1 Pound	℔

(10)	(12)	(8)	(3)	(20)
℔.	℥	ʒ	℈	*gr.*
42	10	7	2	19
17	8	5	2	11
43	7	6	1	10
15	4	5	1	9
47	11	3	1	8
64	9	6	2	15
232	5	4	0	12

(10)	(3)	(20)
ʒ	℈	*gr.*
18	1	14
12	2	17
41	1	10
24	2	15
16	1	11
17	2	15

DRY-MEASURE.

Tyro. What is the uſe of *Dry-meaſure?*

Philo. By this rule are meaſured all dry goods, ſuch as coals, ſand, ſalt, fruit, oyſters, wheat, barley, peas, and other grain, as appears by the two following tables.

TABLE 1.

2	Pints	make	1 Quart
2	Quarts		1 Pottle
2	Pottles, or 8 pints		1 Gallon
2	Gallons, or 16 pints		1 Peck
4	Pecks		1 Buſhel
4	Buſhels		1 Coomb
2	Coomb, or 8 buſhels		1 Seam, or quarter
5	Quarters, or 40 buſhels		1 Load

TABLE 2. *For Coals.*

4	Pecks	make	1 Buſhel
9	Buſhels		1 Quarter of a Chaldron
4	Quarters, or 36 buſhels		1 Chaldron
	Note, 5 Pecks		1 Buſhel, water-meaſure.

Note 1. That 33 *cubic* inches, and 3 fifths, make a *corn* pint; 268 inches, and four-fifths, a *corn* gallon; and 2150 inches, two-fifths, a true *Wincheſter* buſhel, according to act of parliament made in 1697, which ſays, that every round buſhel with an even bottom, that is 18 inches wide, and 8 inches deep, ſhall be deemed a true legal *Wincheſter* buſhel.

(10)	(5)	(8)	(4)	(10)	(4)	(9)	(10)	(36)	(4)
Loads	*qrs.*	*B.*	*Pecks*	*Chal.*	*qrs.*	*Buſh.*	*Chal.*	*B.*	*Pecks*
24	4	7	3	64	2	8	47	31	2
19	3	5	2	17	1	6	19	17	1
49	2	3	1	48	2	3	47	16	2
47	3	1	2	17	1	4	56	14	1
56	1	5	3	96	2	5	17	13	2
17	3	4	2	17	3	7	47	27	3
215	4	4	1						

Note 2. The common received contents of a *corn* gallon is 272 inches. For *dry meaſure* is a mean, as it were, between *wine* and *beer* meaſure. For as 12 *oz. troy* is to 224 inches; ſo is 14 $\frac{12}{20}$ *oz.* to 272 inches nearly. See *note* 3, in *wine meaſure.*

Note 3. That *ſalt*, *ſea-coal*, and many other commodities, are heaped in the meaſuring in general; and where they are not, it is cuſtomary to allow 5 ſtruck-pecks to the buſhel. *Bran* is double meaſure; that is, 2 pecks ſtruck are allowed for one peck.

Obſerve farther.

A ſcore of coals — is 21 chaldron, that is, thoſe that buy 20 chaldron have 21 for 20

A ſack of coals — —	3	Buſhels.
A ſack of corn in common —	4	
A ſack of flour — —	5	
A load, called a market load —	5	
A load in general means —	40	
A wey is 10 quarters, or 2 loads	80	
A laſt in ſome places is 12 wey, *viz.*	960	

See *ſection* 6, *in Addition.*

LIQUID-MEASURE.

Tyro. What is the uſe of this *meaſure?*

Philo. All ſorts of wine, ſpirituous liquors, and beer and ale, are meaſured by it, under the names of *Wine meaſure* and *Wincheſter meaſure.*

1. *Of* WINE-MEASURE.

TABLE.

2 Pints	make	1 Quart
4 Quarts		1 Gallon
10 Gallons		1 Anker of brandy, or rum
18 Gallons		1 Runlet
31½ Gallons		1 Barrel of wine or vinegar
42 Gallons		1 Tierce
63 Gallons		1 Hogſhead
2 Hhds. or 126 gallons		1 Butt, or pipe
2 Pipes, or 252 gallons		1 Tun

Note 1. A *puncheon* is 8 ankers, or 80 gallons; but any caſk between a *hogſhead* and a *pipe*, is called a *puncheon.*

(10)	(2)	(2)	(63)
Tuns	*Pipes*	*Hhds*	*Gall.*
47	1	1	21.
49	0	1	57
64	1	0	16.
45	1	1	18
27	0	0	15
56	1	1	17
291	1	0	18

(10)	(63)	(8)
Hhds.	*Gall.*	*Pints.*
47	19	7
26	14	1
94	17	5
57	47	6
19	14	4
45	49	5

Note 2. *Cyder*, *perry*, *oil*, *vinegar*, &c. are bought and ſold by this meaſure; and milk is alſo ſold in the city of *London* by it; there being no ſtandard to the contrary, corrupt cuſtom has reduced the largeſt of liquid pints to one half its proper quantity.

Note 3. The *wine pint* (according to cuſtom) is reckoned to contain 28 *cubic* inches, and 7 eights; and the gallon 231 inches. But by an experiment made at *Guild-Hall*, in *London*, (1688) a veſſel containing but 224 *cubic* inches, was filled with water, and carefully emptied into the *wine gallon* kept there, which did exactly fill it. But notwithſtandiing *this*, it was thought proper to continue 231 inches to the gallon, which remains to this day. And from this increaſe of the *wine gallon* (anſwering to *troy-weight*) came the increaſe of the *beer gallon*, which anſwers to *avoirdupois-weight.* See *note* 1, in *Wincheſter-meaſure.*

2. WINCHESTER-MEASURE.

Tyro. What are the different meaſures and denominations for *beer* and *ale?*

Philo. They are as under:

TABLE.

2 Pints	make	1 Quart
4 Quarts	make	1 Gallon
9 Gallons	make	1 Firkin
2 Firkins, or 18 gallons	make	1 Kilderkin
2 Kilderkins, or 36 gallons	make	1 Barrel
1 ½ Barrel, or 54 gallons	make	1 Hogſhead
2 Hhds. or 3 bar. or 108 gall.	make	1 Butt
2 Butts, or 216 gallons	make	1 Tun

Note 1. That 35 *cubic* inches 1 quarter make a *beer* pint, and 282 (nearly) 1 gallon, which anſwers to *avoirdupois-weight.* For as 12, the ounces in 1 *lb. troy,* is to 231, the inches in a *wine* gallon; ſo is $14\frac{12}{20}$ ounces to 282, the inches in a cuſtomary beer gallon. See *note* 2, *Troy-weight*.

(10) *Butts*	(2) *Hhds.*	(1½) *Bar.*	(2) *Kild.*	(2) *Firk.*	(9) *Gall.*
15	1	0	1	1	5
23	0	1	0	1	2
41	1	1	1	1	3
22	1	0	1	0	2
7	1	1	0	1	5
1	0	1	1	0	4
113	0	1	1	0	3

(10) *Butts*	(3) *Bar.*	(36) *Gall.*
64	1	27
15	2	18
21	1	14
25	0	15
62	1	16
5	0	29

Note 2. That in guaging *beer* and *ale* in *London,* 32 gallons is a barrel of *ale,* and 36 a barrel of *beer*; but in other places 34 gallons is a barrel, one with another, and *common brewers* in the country allow victuallers 36 gallons of both ſorts to the barrel.

CLOTH-MEASURE.

Tyro. What are the *denominations* of this meaſure?

Philo. Yards, quarters, and *nails:* alſo *ells Engliſh, ells Flemiſh,* and *French ells,* as appears by the table.

TABLE.

2 Inches and a quarter	make	1 Nail
4 Nails	make	1 Quarter of a yard
4 Quarters	make	1 Yard
3 Quarters of a yard	make	1 Ell *Flemiſh meaſure*
5 Quarters, or 1 yd. 1 qr.	make	1 Ell *Engliſh*
6 Quarters	make	1 *French* ell

Note 1. That things in common, ſuch as *woollen, linen, ſilk, tape, cord,* &c. are meaſured by the yard; but *hollands* are in general meaſured by the ell *Engliſh*, and *tapeſtry* by the ell *Flemiſh*.

Note 2. That 16 nails make a yard, 20 nails an ell *Engliſh*, and 12 nails an ell *Flemiſh*.

(10) *Yds.*	(4) *qrs.*	(4) *Nails.*	(10) *Ells Eng.*	(5) *qrs.*	(4) *N.*	(10) *Ells Fl.*	(3) *qrs.*	(4) *N.*
47	3	2	64	4	3	17	2	3
19	2	1	17	2	1	41	1	2
16	3	2	19	3	2	19	2	1
14	1	1	15	4	3	64	1	2
17	1	2	16	2	1	14	2	1
21	2	1	17	2	3	25	1	3
137	2	1						

LONG MEASURE.

Tyro. What does *long meaſure* teach?

Philo. To know the length or breadth of any thing; and the diſtance of one thing, or place, from another, as by the following table.

TABLE.

3	Barley-corns	make	1 Inch
12	Inches		1 Foot
3	Feet		1 Yard
2	Yards, or 6 feet		1 Fathom
5½	Yards		1 Rod, pole or perch
40	Rods		1 Furlong
8	Furlongs		1 Mile
3	Miles		1 League
20	Leagues, or 60 miles		1 Degree
360	Degrees		The circumference of the earth and ſea.

Note 1. An hand, or hand's breadth, in horſemanſhip, is 4 inches.
A common pace is 2 feet 6 inches.
A geometrical pace is 5 feet.

(10) *Deg.*	(20) *Leag.*	(3) *Miles*	(8) *Fur*	(40) *Rods*
25	19	2	7	21.
17	14	1	5	19
16	8	2	2	15.
21	5	1	4	27
47	7	2	1	14.
15	10	1	5	37
144	7	0	3	13

(10) *Rods*	(5½) *Yds.*	(3) *Feet*	(12) *Inches*
42	4	1	11
61	3	0	10
17	1	1	9
24	0	2	8
16	2	1	7
72	1	0	6

Note 2. According to the table, 60 miles make one degree, therefore the earth is 21600 miles round; but 69½ miles (very nearly) make but one degree, and therefore the circumference of the earth is about 25000 miles; as you will ſee in *Reduction*.

LAND MEASURE.

Tyro. What are the denominations of *land meaſure?*

Philo. Almoſt the ſame as in *long meaſure*; but as they never regard the inches and barley corns, this table is ſufficient.

TABLE.

5½ Yards, or 16 feet ½	make	1 Rod, pole or perch
40 Rods or poles		1 Furlong in length
40 Rods in length, and 1 in breadth		1 Rood or quarter of an acre
4 Roods, or quarters		1 Acre

Note 1. That though 16½ feet make a ſtatute pole or rod, yet it is cuſtomary in ſome low, fenny countries, and barren lands, to allow 18 feet, and in meaſuring foreſts 21 feet to the pole.

(10) *Acres*	(4) *Roods*	(40) *Poles*	(5½) *Yds.*
7	1	14.	1
9	3	27	2
4	1	29.	3
15	2	27	4
37	1	18	4½

(10) *Acres*	(4) *Roods*	(40) *Poles*
15	1	19
26	2	24
19	3	27
47	1	15

Note 2. The common inſtrument uſed in meaſuring land is an iron chain, containing 100 links, which is 4 rods, or 22 yards in length; therefore 10 chains in length, and 1 in breadth, make an acre, and 80 chains in length only make a mile, or 1760 yards.

SQUARE MEASURE.

Tyro. What do you mean by *ſquare meaſure?*

Philo. You are not to expect, *Tyro*, as yet to know the nature of it; it is ſufficient, at preſent, that you only know this, that *long meaſure* ſhews you only the length or breadth of any thing; but *ſquare meaſure* tells you the content of any thing, which you can have no notion of till you have learnt *Diviſion*; but it will not be amiſs to learn the following table by heart (at your leiſure) that you may be the better able to underſtand it by and by.

16	Square quarters	make	1 Square inch
144	Square inches		1 Square foot
9	Square feet		1 Square yard
30	Square yards, 1 qr. or 272 ſquare feet 1 quarter		1 Square rod, or pole
160	Square rods		1 Acre of ground

Note, An example or two will be ſufficient.

(10) *Yards*	(9) *Feet*
45	6
29	3
47	8
25	5
148	4

(10) *Yards*	(9) *Feet*	(144) *Inches*	(16) *Qrs.*
17	5	71	3
64	2	14	6
16	4	17	12
78	5	94	11

Of TIME.

Tyro. What is *time*, and how is it divided?

Philo. *Time* ſhews us the beginning, mutation, (or changing) continuation, and ending of all mutable things. It is meaſured by *years*, *months*, *days*, *hours*, *minutes*, and *ſeconds*, and divided as follows, which will ſerve all common purpoſes.

TABLE.

60″ Seconds	make	1 Minute of time
60′ Minutes	make	1 Hour
24 Hours	make	1 Natural or real day
7 Days	make	1 Week
4 Weeks	make	1 Month
13 Months or 365 Days	make	1 Year

Note 1. Though the table ſays 13 months, or 365 days, make a year, yet it is not truly ſo; for 13 months (allowing four weeks to the month, is but 364 days; whereas 13 months, 1 day, 6 hours, make a year; for theſe odd 6 hours make 24 hours, or 1 day, every fourth year, which is added to *February*, which has then 29 days, and is called *leap year:* but a true year is 365 days, 5 hours, 48 minutes, and is called a *ſolar year*, being the time that the ſun performs its apparent revolution through the *ecliptic*; but you muſt not buſy yourſelf, and loſe your time about theſe things, which are too hard for you to underſtand at preſent.

Note 2. Though 13 months are ſaid to make a year, and ſervants commonly reckon a month 28 days; yet you are to obſerve, that in trade and tranſacting buſineſs, by a month is meant a *calendar month*; that is, from any day of the month to the ſame day of the next month: thus, from the 5th of *February* to the 5th of *March*, or from the 18th of *April* to the 18th of *May*, is a month.

EXAMPLE 1.

(10) *Yrs.*	(13) *Mths.*	(4) *Wks.*	(7) *Days*
27	11	3	6
43	9	2	5
27	5	1	4
36	1	2	3
45	10	2	1
28	12	1	4
209	12	2	2

EXAMPLE 2.

(10) *Days*	(24) *Hrs.*	(60) *Min.*	(60) *Sec.*
41	22	50	27
17	17	17	15
24	15	27	14
19	21	19	24
27	11	18	19
35	14	25	25

Note 3. In *example* 2, you muſt point or dot at every row but the laſt.

And now, *Tyro*, I think you may by this time be perfect in *Addition*, I ſhall only ſet you a few queſtions, and proceed to *Subtraction*.

SECTION VII.

Containing ſome other uſeful Things neceſſary to be known in Number, Weight, *and* Meaſure.

Note 1. *Of things bought or ſold by the* dozen, ſcore, *or* groſs.

A *Dozen* is 12. A *ſcore* is 20. A *common hundred* is 100. A *long hundred* is 120. A *groſs* is 12 dozen, or 144, and a *great groſs* is 12 times as many, or 1728. *Oranges* and *lemons*, *corks*, *bungs*, and many other things, are bought and ſold by the *dozen* or *groſs*. *Herrings*, and ſeveral other ſorts of fiſh, and all ſorts of *nails*, and many ſuch ſmall things, have ſix ſcore, or 120, to the hundred; but a hundred of *ling cod* is 124 in number; and a hundred books in printing is 104.

Note 2. *Of* PARCHMENT *and* PAPER.

1 dozen is 12 ſkins; 5 dozen one roll of *parchment*; 24 and ſometimes 25 ſheets make a quire of *paper*, 20 quires 1 ream, and 10 ream 1 bale.

Note 3. *Of the different Sizes of* BOOKS.

Folio is the largeſt of all books, and has but two leaves to the ſheet. *Quarto* (marked 4*to*) has four leaves to a ſheet. *Octavo* (or 8*vo*) is a ſheet doubled into 8 parts, and *duodecimo* (commonly called *twelves*, and marked 12*mo*) has 12 leaves to the ſheet.

Note 4. *Of* WEIGHT, MEASURE, *&c.*

A *faggot* of ſteel 6 ſcore, or 120*lb.* A *burthen* or *gad* of ſteel 9 ſcore. A *barrel* of anchovies 30*lb.* A *barrel* of figs from 98 to 300*lb.* A *barrel* of gunpowder

1 *Cwt.* A *puncheon* of prunes from 10 to 12 *Cwt.* A *ton* or *fother* of lead 19 *Cwt.* 2 *qrs.* A *quintal* of fiſh 100 in tale. A ſtone of iron, ſhot, or horſeman's weight 14*lb.* A *ſtone* of meal 8*lb.* A *ſtone* of hemp 32*lb.* A *ſtone* of glaſs 5*lb.* A *ſeam* of glaſs 24 *ſtone*, or 120*lb.* A *keg* of herrings, &c. 60 in number, an hundred is 120. A *cade* of *ſprats* 1000. A *cade* of herrings 500. A *barrel* 1000. A *laſt* 12 barrels, or 12,000. A *laſt* of corn of rape-ſeed 10 *qrs.* A *laſt* of gunpowder 24 barrels. A *laſt* of leather 20 dickers. A *dicker* 10 ſkins. A *laſt* of hides 12 dozen; of tar 14 barrels; of wool 12 ſacks; of flax or feathers 1700*lb.* A *wey* in ſome places is 5 chaldron. A *wey* of meal 6 *qrs.* A gallon of train oil 7½*lb.* A *tun* 252 gallons. A *tun* of ſweet oil 236 gallons. A *load* of hay in ſome places is 25, in others 30 *cwt.* In *London* it it ſold in *truſſes*, containing 56, or 60*lb.* a truſs, and 36 truſſes to the load. A *load* of *Scotch* coals 1 *cwt.* A load of tiles 1000. Of bricks 500. Bricks in general are 9 inches long, 4½ inches broad, and 2½ thick. A *ſquare* of tiling or thatching contains 10 feet every way, that is 100 feet, and a rod of brick work 272 feet, 1 quarter; but 272 is reckoned for common work. A *ſtack* of wood is 3 feet high, 3 feet wide, and 12 feet long; but this is according to the agreement of the maſter and the workmen.

Tyro. I am extremely obliged to you, ſir; but pray am I bound to get theſe things by heart before I learn *ſubtraction?*

Philo. Not at all, *Tyro:* to learn the rules and the common tables is ſufficient. The others I have only added for your further inſtruction: They are not ſet you for a taſk, but for your diverſion; and if you now and then read them over, you will ſoon find the benefit of thus improving your mind; ſince it will naturally gain you the good-will of your parents, your maſter, and mankind in general, rather than ſquandering away your time in idleneſs and miſchief, beſides the diſgrace of living and dying a dunce.

SECTION VIII.

Containing ſome uſeful and diverting Queſtions to exerciſe the Learner in ADDITION *only.*

Queſt. 1. A Man borrowed of his friend a certain ſum of money, and paid him in part 15*l.* 10*s.* and left unpaid 24*l.* 10*s.* What did he borrow? *Anſ.* 40*l.*

Rule. *Adding the two ſums together gives the anſwer.*

2. Suppoſe a perſon was born in 1709, when will he be fourſcore years old? *Anſ.* in 1789.

Rule. *Add as many to* 1709 *as will make it* 1786, *is the anſwer.*

3. *A*, *B* and *C* agreed to purchaſe an eſtate. *A*, laid out, or paid for his part, 140*l.* 10*s.* *B* paid 217*l.* 10*s.* *C* paid 500*l.* 10*s.* What did the eſtate coſt? *Anſ.* 858*l.* 10*s.*

Rule. *Add all the ſums together.*

4. A factor bought 4 bags of hops; the firſt (No. 1.) weighed 2 *C.* 1 *qr.* 14*lb.* No. 2. 3 *qrs.* 17*lb.* No. 3. 2 *C.* 3 *qrs.* 13*lb.* And No. 4. weighed 1 *qr.* 27*lb.* What is the weight of all? *Anſ.* 6 *G.* 2 *qrs.* 15*lb.* *Add all together is the anſwer.*

5. A ſhopkeeper having opened a ſhop, ſold the firſt day as many goods as came to 15*l.* 13*s.* 7*d.* $\frac{3}{4}$, and thus he went on for one week, (*viz.* 6 days.) How much did he take in all? *Anſ.* 94*l.* 1*s.* 10*d.* $\frac{1}{2}$.

Rule. *Set down* 15. 13. 7. $\frac{3}{4}$. *ſix times, and adding them together gives the anſwer.*

6. A farmer carried out 100*l.* in order to buy cattle, and brought home but 34*l.* 15*s.* 6*d.* What did he lay out? *Anſ.* 65*l.* 4*s.* 6*d.* For theſe two ſums added together make juſt 100*l.* and ſo on for any other ſum.

DIALOGUE III.

SECTION I.

SUBTRACTION *in whole Numbers.*

Tyro. WHAT does *ſubtraction* teach?

Philo. *Subtraction* teaches to take a *leſs number* from a *greater* to diſcover the *difference*. To prove the work, add the *difference* to the *leſs number*, and if that ſum be the ſame as the *greater*, the work is right, otherwiſe falſe.

Tyro. How is *ſubtraction* performed?

Philo. Quite contrary to *addition*; for in *addition* you uſe the word *and*, but *here* you uſe the word *from*. Thus 4 *from* 7, that is, 4 *taken out of* 7, there remains 3, for the *difference*. Again, 5 *from* 10, there remains 5; and 6 *from* 14, there remains 8, and ſo for any other numbers, as you may ſee by the following example:

	EXAMPLE 1.	EX. 2.	EX. 3.	EX. 4.
	£.	*Yards.*	*Ells.*	*lbs.*
Greater number	27	95	468	441756
Leſſer number	14	61	162	240256
Difference	13	34	306	201500
Proof	27	95		

The WORK *in Words at Length.*

In *Example* 1, I ſay, 4 *from* 7 there remains 3; and 1 *from* 2 there remains 1. *To prove it*, I add the *difference* to the *leſs number*, ſaying, 3 *and* 4 is ſeven, *and* 1 *and* 1 makes 2. In *Ex.* 2, I ſay, 1 *from* 5 there remains 4; and 6 *from* 9 there remains 3. *Proof*, I ſay, 4 and 1 is 5; 3 and 6 is 9: That is, 34 and 61 added together make 95, and ſo for the other examples.

Tyro. This is quite plain indeed.

Philo. I ſhall work *examples* 3 and 4 in the ſame manner, and leave you to prove them as I have directed.

Obſerve then, *Ex.* 3, I ſay, 2 *from* 8 there remains 6; then 6 *from* 6, or 6 taken out of 6, there remains 0, and 1 from 4 there remains 3. *Laſtly*, in *Ex.* 4, I ſay, 6 *from* 6 there remains 0; then 5 from 5 there remains 0; 2 *from* 7 there remains 5; then 0 from 1, that is nothing taken out of 1, there ſtill remains 1; then 4 *from* 4 there remains 0, and 2 *from* 4, 2.

Note, I ſhall give you an example or two with, and without cyphers, that you may endeavour to avoid that idle cuſtom.

	Ex. 5, *with cyph.*	*without*	Ex. 6, *with cyph.*	*without*
From	24526	24526	84257	84257
Take	00012	12	84215	84215
Anſ.	24514	24514	00042	42

Tyro. I own that the examples without the cyphers look beſt, and I underſtand very well what you have ſhewn me.

Philo. I ſhall leave you then 3 or 4 examples for practice.

	Yards	*Ells*	*Hundreds*
From	47162	94785	347621
Take	12412	3104	301

Tyro. Now, ſir, be pleaſed to ſhew me how to ſubtract or manage a ſum, when the lower figure is ſome times larger than the top one; for I think that it appears difficult to me at preſent.

Philo. Never fear; you will ſoon find it eaſy, if you do but obſerve the following rule.

2. *When the lower figure is larger than the top one, the* rule *is*,

Take the lower figure out of what you do by, which (in *whole numbers*) you know is *ten*, and to that difference, or remainder, add alſo the top figure, and *that* is the true difference, which place under the firſt row. This is what is called *borrowing* in *ſubtraction*, therefore remember that you are always to carry 1 to the next lower figure for ſo doing: an example or two will make it quite plain.

	Ex. 1.	Ex. 2.	Ex. 3.	Ex. 4.
	£.	*Ells*	*Yards*	*Buſhels*
From	762	85420	760410	5217624
Take	145	17273	457146	3471276
Difference	617	68147		

Here, in *Ex.* 1, I ſay, 5 out of 2 I cannot have; therefore I take 5 out of 10, (which is what I do by here) and there remains 5, and the top figure 2 makes 7, which I place under the firſt row, and carry 1 to the next lower figure; ſaying, 1 that I carry to 4 makes 5, which taken out of 6, that is, 5 from 6 there remains 1; but now I carry nothing to the next figure, becauſe the lower figure being leſs than the top one, I had no occaſion to borrow, therefore I only ſay in the laſt row, 1 from 7 there remains 6. Again, in *Ex.* 2, I ſay, 3 from 0 I can't, but 3 from 10 there remains 7, and 0 is 7 ſtill; then I carry 1 to 7 is 8 from 2 I can't, but 8 from 10 there remains 2, and the top figure 2 makes 4: then I carry 1 to 2, which is 3, ſaying 3 from 4 there remains 1; but now I do not carry any to the next figure, becauſe I did not borrow, but only ſay, 7 from 5 I can't take, but 7 from 10 there remains 3, and the top 5 makes 8. *Laſtly*, I carry 1 to 1 is 2 from 8 there remains 6.

Tyro. This is plain enough.

Philo. This is the eaſieſt way for a learner, but there is another method which is more practicable and expeditious, if you mind and learn it.

Another way to ſubtract, *when the lower figure is larger than the top one.*

When you cannot take the lower figure from the top one, then count the top figure ten more than it really is. Thus, if the top figure be 2, call it 12: if 3, call it 13; if 5, call it 15; if 8, call it 18, &c. and then take the lower figure from it, and you have the true *anſwer* or *difference*; but always remember to carry 1 to the next figure for ſo doing. This is called borrowing *ten*, and your carrying 1 to the next figure is paying of it again.

EXAMPLES.

	£.	*Yards*	*Ells*
From	75043	41725	172560
Take	27365	17258	87275
Difference	47678	24467	
Proof	75043	41725	

Firſt, I ſay, 5 from 3 I can't; but calling 3, 13, I ſay, 5 from 13, there remains 8; then I carry 1 to 6 is 7 from 4 I can't, but I ſay, 7 from 14 there remains 7; then I carry 1 to 3 is 4 from 0 I can't, but 4 from 10 there remains 6. Again, I carry 1 to 7 is 8 from 5 I can't, but 8 from 15 there remains 7. *Laſtly*, I carry 1 to 2 is 3 from 7 and there remains 4.

☞ *Note*, Though the bottom figures in *ſubtraction* may be larger than the top ones; yet you are to remember the laſt lower figure is never larger than the top one when there is an equal number of figures.

Tyro. I underſtand you very well, ſir.

Philo. Then I ſhall only leave you an example or two, to try as you have leiſure.

More EXAMPLES.

	£.	*lb.*	*Miles*
From	417215	62170071	417621700
Take	241729	7210943	631720
Difference			

SECTION II.

Of MONEY.

Tyro. HOW is *ſubtraction of money* performed?

Philo. By taking or ſubtracting every denomination in the lower line out of or from the upper ſum, as will appear more plain by the 2 following rules.

Rule 1. When the lower figures in the *farthings*, *pence*, or *ſhillings*, are ſmaller than the top ones, then only ſubtract or take one from the other, and the remainder is the true *anſwer* or *difference*, which is placed under each row to which it belongs.

Rule 2. When the lower figures in the *farthings*, *pence*, or *ſhillings*, are larger than the top ones; then ſubtract or take the lower figure out of what you do by; that is, take the lower *farthings* out of 4, the lower *pence* out of 12, and the lower *ſhillings* out of 20, taking in the top figure beſides; ſo ſhall this be the true difference or anſwer; but remember, that you are always to carry 1 to the next figure for borrowing, as you did in *whole numbers*.

Tyro. Pleaſe to give me an example or two, I ſhall ſoon underſtand it.

Philo. You cannot miſs if you mind the rule well.

	Ex. 1.			Ex. 2.			Ex. 3.		
	£.	s.	d.	£.	s.	d.	£.	s.	d.
From	9	8	11	48	15	5	643	14	6¾
Take	7	5	6	27	11	3	231	11	2¼
Rem.	2	3	5	21	4	2	412	3	4½
Proof	9	8	11	48	15	5	643	14	6¾

1. I begin at the pence in example 1, ſaying, 6 from 11 pence there remains 5 pence, which I place under the pence; then I ſay, 5 ſhillings from 8 there remains 3 ſhillings; and 7 pounds from 9 there remains 2. So the *difference* is 2*l*. 3*s*. 5*d*.

PROOF.

The work is proved like *whole numbers*, by adding the *difference* to the *lower* or *leſſer number*: thus, 5 pence and 6 is 11 pence; then 3 ſhillings and 5 make 8 ſhillings; and two added to 7 make 9 pounds.

In example 2, I ſay, 3 from 5 there remains 2 pence; then 11 from 15 there remains 4; then 7 from 8 there remains 1; and 2 from 4 there remains 2. *Ex*. 3, having farthings, I ſay, 1 farthing from 3 there remains 2 farthings, which I ſet down thus ½; then 2 from 6 there remains 4 pence; then 11 from 14 ſhillings there remains 3. *Laſtly*, for the pounds, I ſay, 1 from 3 there remains 2; then 3 from 4 there remains 1; and 2 from 6 there remains 4: ſo is the *difference* or *anſwer* 412*l.* 3*s.* 4*d.* ½. Now if you add 412*l.* 3*s.* 4*d.* ½ to the lower ſum 231*l.* 11*s.* 2*d.* ¼, you will find they amount to the ſame as the top ſum, *viz.* 643*l.* 14*s.* 6*d.* ¾.

Note, After this manner is every ſum done and proved, in *ſubtraction.*

More Examples for Practice.

From	471 - 11 - 2¼	576 - 19 - 11½	409 - 11 - 5¾
Take	120 - 10 - 2	132 - 13 - 4¼	304 - 11 - 3½
Rem.			

2. *When the* ſhillings, pence, *and* farthings, *are larger in the lower line than in the top one.*

	EXAMPLE 4.			EXAMPLE 5.			EXAMPLE 6.			
	(10)	(20)	(12)	(10)	(20)	(12)	(10)	(20)	(12)	(4)
	£.	s.	d.	£.	s.	d.	£.	s.	d.	
Lent	10	4	6	42	11	6	453	13	5	¼
Received	7	10	8	17	14	10	326	15	8	¾
Due	2	13	10	24	16	8	126	17	8	½
Proof	10	4	6	42	11	6	453	13	5	¼

Here I ſay, 8 pence from 6 pence I can't, but 8 from 12 (which is what I do by at pence) there remains 4, and the top 6 makes 10: then I carry 1, becauſe I borrowed, ſaying, 1 that I carry to 10 is 11 ſhillings, which from 4 I can't take, but 11 from 20 (which is what I do by) there remains 9, and the top 4 makes 13. *Laſtly*, I carry 1 to 7 is 8 from 10 there remains 2.

PROOF.

I prove theſe examples the ſame way as before, by adding the *difference* to the *leſſer ſum*, ſaying, 10 pence and 8 is 18 pence, that is, 6 pence above a ſhilling, or 12 pence; and I carry 1 to 13 is 14, and 10 is 24, which is 4 above 20 ſhillings, or 1*l.* *Laſtly*, I carry 1 to 7 is 8, and 2 makes 10.

Now, *Tyro*, pray try at *Example* 6, where there are farthings.

Tyro. In *Example* 6, I ſay, firſt, 3 farthings from 1 farthing I can't, but 3 farthings from a penny, or 4 farthings, there remains 1, and the top farthing makes 2 farthings, which I ſet down thus ½: then I carry 1 to 8 pence is 9 pence, which from 5 pence I can't have, but 9 from 12 there remains 3, and the top 5 makes 8 pence: again, I carry 1 to 15 is 16 from 13 I can't, but 16 from 20 there remains 4, and the top 13 is 17 ſhillings. *Laſtly*, I carry 1 to 6 is 7 from 3 I can't, but 7 from 13 there remains 6; or 7 from 10 there remains 3, and the top 3 is 6: then I carry 1 to 2 is 3 from 5 there remains 2; but now carry none, becauſe I did not borrow; therefore I only ſay 3 from 4 there remains 1.

P R O O F.

I prove this, as before directed, ſaying, 2 farthings and 3 is 5 farthings, which is 1 farthing above a penny, and I carry a penny to 8 is 9, and 8 is 17 pence, 5 above 12, and I carry 1 to 17 is 18, and 15 is 33, which is 13 above 20, and I carry 1 to 6 is 7, and 6 is 13, which is 3 above 10, and I carry 1 to 2 is 3, and 2 is 5; then I ſay, 1 and 3 is 4.

Philo. You have done very well indeed; I ſhall only ſet you an example or two for practice.

EXAMPLES *for Practice.*

	£.	s.	d.		£.	s.	d.
Borrowed	217	10	0	*Debtor*	1000	00	0
Paid	109	15	8¼	*Creditor*	910	15	6½
To pay				*Balance*			

Tyro. Theſe I can do very well; therefore wiſh you would ſhew me how to balance an accompt, or make out a ſmall reckoning.

Philo. That I will.

3. *Practical Queſtions for Buſineſs.*

		£. s. d.
Queſt. 1. *A* borrowed of *B* ——		100 - 00 - 0
A paid him at one time	21 - 14 - 6	
At another 10 guineas, *viz.*	10 - 10 - 0	
At another 20 guineas, *viz.*	21 - 00 - 0	
At another time ——	5 - 15 - 0	
Sold him goods amounting to	18 - 14 - 9	
	77 - 14 - 3	
	In all	77 - 14 - 3
What is ſtill due to *B?*	*Anſwer*	22 - 5 - 9

Rule. I add up together all the ſums that *A* paid at different times, and find they amount to 77*l.* 14*s.* 3*d.* which I place under 100*l.* and ſubtracting it therefrom, I find that there is ſtill due io *B* 22*l.* 5*s.* 9*d.* *anſwer.*

Queſt. 2. *A* Blackſmith *delivered a Bill to a* Farmer, *of* 45*l.* 14*s.* 6*d.* ¼, *and the* Farmer *has paid him in part as under:*

	£. s. d.
By caſh —— ——	20 - 00 - 0
By 10 buſhels of malt ——	1 - 15 - 0
By a load of hay —— ——	1 - 16 - 0
By meat at ſeveral times ——	2 - 7 - 6
By 14 buſhels of oats ——	2 - 11 - 0
By 20 buſhels of wheat ——	4 - 7 - 3
	32 - 16 - 9

Blackſmith's bill ——	45 - 14 - 6¼	
Farmer's bill ——	32 - 16 - 9	
Balance due to the *Blackſmith*	12 - 17 - 9¼	*Anſwer.*

Queſt. 3. A *ſteward* collected as much money for rents as amounted to — £.4000

And remitted to his maſter as under:

	£	s	d
By caſh at one time	500		
At another	500		
At another	210		
At another	420		
By tax bills diſcounted	41	15	6¾
By repairs done to the eſtate	641	14	9
By other charges	15	13	6
Diſburſed in all £.	2329	3	9¾
Which taken from the top £. 4000 there remains due to his maſter	1670	16	2¼

Tyro. I underſtand you well.

Philo. Then I will leave you one *queſtion* for practice, and you may do the work at leiſure.

Queſt. 4. Two perſons, *A* and *B*, have a reckoning to ſettle as follows: *A* lent *B* £.300, and ſome time after lent him 100 guineas more: *B* paid him at 3 ſeveral times, each 100 guineas, and at another time gave him a *draught* or *note* upon *C* for £.50, and ſold him as many goods as came to £.34 - 4 - 6: now I demand how the balance ſtands between them. *Anſ.* there is ſtill due to *A* £.5 - 15 - 6. To prove it.

Rule. Add the two ſums that *A* lent to *B* together, and you will find them £.405; then ſet all that *B* paid in caſh, and the *draught* and goods, all under one another, and add them together, which makes £.399 - 4 - 6: this being done, ſet £.399 - 4 - 6 under £.405, and *ſubtract* it therefrom, and you will find there remains £.5 - 15 - 6 due to *A* on balance.

Tyro. I will try it directly, and am ſure it is eaſy enough, but your anſwer will be ſome help to me, I own.

Philo. As every accompt of *debtor* and *creditor* is ſettled after this manner, I ſhall give no more examples, expecting by this time you are capable of ſetting yourſelf queſtions; and if you are not, it is highly neceſſary to look over the examples once more, then will you be duly qualified for thoſe queſtions I ſhall ſet you at the end of *Subtraction*; and therefore we will proceed to *Weights* and *Meaſures*, where you will find ſome examples done for your inſtruction, and ſome left undone for your practice.

AVOIRDUPOIS WEIGHT.

	Tons	*C.*	*qr.*	*lb.*		*C.*	*qr.*	*lb.*	*oz.*	*dr.*
Bought	17	11	1	15	*Bought*	47	1	17	11	14
Sold	14	17	3	21	*Sold*	19	0	25	10	15
Unſold	2	13	1	22	*Unſold*					

Now, *Tyro*, I ſhall ſhew you this firſt *example*, but no more; becauſe all other ſums in every one of the rules are done in the ſame manner, and there is no occaſion for further inſtruction.

Firſt, I ſay, 21 from 15 I can't, but 21 from 28 (which is what I do by at *lbs.*) there remains 7, and 15 makes 22: then I carry 1 to 3 is 4 from 1 I can't, but 4 from 4 (which is what I do by at *qrs.*) there remains 0, but the top 1 is 1, which I ſet down. Again, I carry 1 to 17 is 18 from 11 I can't, but 18 from 20 there remains 2, and the top 11 makes 13. *Laſtly*, I carry 1 to 4 is 5 from 7 there remains 2, and the work is done.

Tyro. I thank you, ſir; examples now without words will be ſufficient.

Note, If you forget what you do by, turn to your tables in *Addition*.

TROY WEIGHT.

	lb.	*oz.*	*dwt.*	*gr.*		*lb.*	*oz.*	*dwt.*	*gr.*
Bought	14	5	15	14	*Bought*	214	10	17	11
Sold	9	9	13	17	*Sold*	109	10	17	15
Rem.	4	8	1	21	*Remains*				

DRY MEASURE.

	Loads	*buſh.*	*pecks*	*pints*
Bought	42	17	2	12
Sold	17	34	2	14
Unſold	24	22	3	14

	Chal.	*buſh.*	*pecks*
Bought	291	21	2
Sold	173	27	3
Unſold			

WINE MEASURE.

	Butts	*hhds.*	*gall.*	*pints*
Bought	14	1	47	0
Sold	9	0	51	5
Unſold	5	0	58	3

	Hhds.	*gall.*	*pints*
Bought	64	35	1
Sold	17	46	2
Unſold			

WINCHESTER MEASURE.

	Bar.	*gall.*	*pints*
Brewed	124	21	4
Sold out	92	27	6
Unſold	31	29	6

	Butts	*hhds.*	*bar.*	*gall.*
Brewed	21	1	1	20
Sold out	15	1	0	26
Unſold				

Note, I have reckoned 36 gallons to the barrel, that being cuſtomary in ſelling beer in moſt places, as I ſaid before.

CLOTH MEASURE.

	Yds.	*qrs.*	*N.*	*EllsEng.*	*qrs.*	*N.*	*EllsFl.*	*qrs.*	*N.*
Bought	147	1	0	47	1	3	47	2	0
Sold	96	3	2	18	2	3	29	2	1
Rem.	50	1	2						

LONG MEASURE.

	Deg.	*leag.*	*miles*	*fur.*	*rods*	*yds.*	*feet*	*inch.*	*B. corn*
From	471	14	1	3	57	2	1	10	1
Take	167	17	1	5	21	3	1	10	2
Rem.	303	16	2	5	35	3$\frac{1}{2}$	2	11	2

LAND-

LAND MEASURE.

	Acres	*roods*	*poles*	*yds.*	*Acres*	*roods*	*poles*
From	471	2	15	3	47	1	15
Take	196	2	26	4	19	2	15
Rem.	274	3	28	4½			

TIME.

	Yrs.	*mths.*	*wks.*	*days*	*hours*	*Days*	*hours*	*min.*	*ſec.*
From	219	10	3	3	17	45	17	25	17
Take	193	11	3	4	20	19	21	43	35
Rem.	25	11	3	5	21				

Note, In the firſt example I reckon 13 months to a year.

Tyro. Sir, I am obliged to you for the pains you have taken; I underſtand you very well, and will try at all thoſe ſums you have left undone.

Philo. That is enough, we will finiſh *Subtraction* then with *Section* 3.

SECTION III.

Containing ſome uſeful QUESTIONS *to exerciſe the Learner in both* RULES.

Queſt. 1. KING *Henry* the *Eighth* died 1547; I demand how many years it is, this being now 1786? *Anſwer* 239 years.

Queſt. 2. Suppoſe this preſent year 1786, you were 19 years old, what year was you born in? *Anſ.* 1767.

Queſt. 3. A boy had 1000 marbles, and he loſt at 3 different times at play, each 175, and at another time 150; how many has he ſtill in hand? *Anſ.* 325.

Rule. Set down 175 three times, add 150 under that, and then add all of them together, and take the ſum out of 1000, and the anſwer will be 325 left.——This *rule* ſerves for all that follows.

MONEY.

4. *A* lent *B* £.500, and *B* paid him four times, each £.120 - 10. What is due to *A?* *Anſ.* £.18.

5. What ſum of money muſt I add to £.58 - 14 - 6¾ to make it up £.100? *Anſ.* 41 - 5 - 5¼.

6. *A proof to Queſt.* 5. What ſum muſt I take out of £.100, to have the remainder £.58 - 14 - 6¾. *Anſwer* £. 41 - 5 - 5¼.

7. A collector of the exciſe received £. 2040 - 14 - 5¼, and remitted or paid at 3 ſeveral times, each £. 500, and at another time 100 guineas; what has he ſtill in hand? *Anſ.* £. 435 - 14 - 5¼.

AVOIRDUPOIS WEIGHT.

8. Bought 6 *ton*, 14 *cwt.* of iron, and ſold at one time 3 *ton*, 11 *cwt.* 3 *qrs.* and at ſeveral other times ſold by retail 15 *cwt.* 3 *qrs.* 17 *lb.* What remains unſold? *Anſ.* 2 *ton*, 6 *cwt.* 1 *qr.* 11 *lb.*

TROY WEIGHT.

9. A gentleman delivered to a ſilverſmith 2 *lb.* 5 *oz.* 11 *dwts* of ſilver; and he received a ſilver cup, which weighed 11 *oz.* 14 *dwts.* and at another time 6 large ſpoons, weighing 1 *lb.* 2 *oz.* 3 *dwts.* 14 *grs.* What weight of ſilver has the ſilverſmith ſtill in hand? *Anſ.* 3 *oz.* 13 *dwts.* 10 *grs.*

LIQUID MEASURE.

10. A common brewer has 2 goils of new beer, containing 32 butts, 2 barrels, 24 gallons of ſtrong; and 15 butts, 1 barrel of ſmall. And he ſent to one victualler 8 butts, 2 barrels; to another 11 butts; and ſtarted into his own ſtorehouſes 5 butts, 2 barrels, 27 gallons of the ſtrong; and of the ſmall, 7 butts, 2 barrels; he alſo ſold out by retail, of the ſmall, 4 butts, 23 gallons: I demand what remains of the brewing, both of the goil of ſtrong and the goil of ſmall? *Anſw.* 7 butts, 33 gallons of ſtrong, and 3 butts, 1 barrel, 13 gallons of ſmall.

☞ *Note*, I have added the anſwers, that you may know when you are right or wrong; if you cannot do all theſe queſtions as yet, it is of no great ſignification; you muſt not ſtop your progreſs in going forward, becauſe of that. Now follows

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DIALOGUE IV.

SECTION I.

MULTIPLICATION.

Tyro. WHAT is *Multiplication?*

Philo. Multiplication is a compendious or ſhort way of *addition*, and teaches us to tell the product of any ſum in one line only, which would require ſeveral *additions*.

Tyro. What elſe is required?

Philo. There are three things to be carefully obſerved in *multiplication*.

Firſt. The *multiplicand*, which ſtands a-top, and is that number given to be multiplied.

Secondly. The *multiplier*, or ſum you multiply by.

Thirdly. The *product* or *anſwer*, which is the *multiplicand* multiplied by the *multiplier*.

Tyro. Pleaſe to explain this a little more.

Philo. Let us take any two numbers, ſuppoſe 8 and 3, I ſet down 8, and place 3 under it; ſo is 8 the *multiplicand*, 3 is the *multiplier*, and 24 is the *product*, or *anſwer*, becauſe 3 times 8 make 24. Is this plain enough?

Tyro. Yes, ſir, I underſtand you now.

Philo. Very well, *Tyro*, then I would have you get the following table by heart, by all means, notwithſtanding it is too cuſtomarily omitted.

MULTIPLICATION TABLE.

Once	1	is	1
2 times, or twice	2	is	4
	3		6
	4		8
	5		10
	6		12
	7		14
	8		16
	9		18
3 times	3	is	9
	4		12
	5		15
	6		18
	7		21
	8		24
	9		27
4 times	4	is	16
	5		20
	6		24
	7		28
	8		32
	9		36
5 times	5	is	25
	6		30
	7		35
	8		40
	9		45
6 times	6	is	36
	7		42
	8		48
	9		54
7 times	7	is	49
	8		56
	9		63
8 times	8	is	64
	9		72
9 times	9	is	81
10 times	10		100
11 times	11		121
12 times	12		144

Table of Twelves

12 times	2	is	24
	3		36
	4		48
	5		60
	6		72
	7		84
	8		96
	9		108
	10		120
	11		132
	12		144

Note 1. You ſhould be very careful to get the *table* by heart, as I ſaid before; ſaying thus, 2 times 2, or twice 2 is 4, twice 3 is 6, twice 4 is 8, twice 5 is 10, *&c.*

Note 2. You ſhould alſo at leiſure learn to *box* the *table* well: that is, to ſay it backwards, forwards, or any way. Thus you ſee twice 5 is 10, that is, 5 times 2 is 10. Again, 3 times 9 is 27; ſo alſo is 9 times 3 the ſame. So 6 times 12 is the ſame as 12 times 6, and 5 times 9 the ſame as 9 times 5.

1. *To multiply by ſingle Figures.*

Rule. Multiply every figure in the *multiplicand* by the figure in the *multiplier*, carrying 1 for every 10, as in *Addition of whole Numbers*, and you have the *product* or *anſwer*.

EXAMPLE 1.		EXAMPLE 2.	
Multiplicand	17	*Multiplicand*	78
Multiplier	5	*Multiplier*	6
Product	85	*Product*	468

I begin with the *multiplier* 5, ſaying, 5 times 7 is 35, and ſet down the 5, and I carry 3; then I ſay 5 times 1 is 5, and 3 that I carried is 8; ſo is the *product* or *anſwer* 85. Again,

In *Ex.* 2, I ſay, 6 times 8 is 48; that is 8 and I carry 4; then 6 times 7 is 42, and 4 I carried is 46: ſo is this *product* 468.

To prove the Work by Addition.

I ſet the *multiplicand* 17 down 5 times; and the *multiplicand* 78 I ſet down 6 times, and adding them together, I find 85, and 468, as before; which you may try on your ſlate at leiſure.

Tyro. I ſee plainly that *multiplication* ſaves the trouble of many *additions*.

Philo. There is another way to prove *addition*; but as it is of no manner of ſignification, we will lay aſide thoſe puzzling curioſities, and proceed to

EXAMPLE 3.		EXAMPLE 4.		EXAMPLE 5.	
Multiply	472		24970	and	590407
by	8	*by*	9	*by*	7
Anſwer	3776	*Anſ.*	224730	*Anſ.*	4132849

Tyro. I ſay, 8 times 2 (or twice 8) is 16, 6 and I carry 1; then 8 times 7 is 56, and 1 is 57, that is 7 and I carry 5; then 8 times 4 is 32, and 5 I carried is 37. In *Ex.* 4, I ſay, 9 times (0) nothing is 0; then 9 times 7 is 63, that is, 3 and I carry 6; then 9 times 9 is 81, and 6 I carried is 87, that is 7 and I carry 8; then 9 times 4 is 36, and 8 is 44, that is 4 and I carry 4; and *laſtly*, 9 times 2 is 18, and 4 I carried is 22. Alſo in *Ex.* 5, I ſay, 7 times 7 is 49, that is 9 and I carry 4; 7 times 0 is 0, but 4 is 4 ſtill; then 7 times 4 is 28, that is 8 and I carry 2; then 7 times 0 is 0, but 2 is 2; then I carry none, but ſay, 7 times 9 is 63, that is 3 and I carry 6; and *laſtly*, 7 times 5 is 35, and 6 is 41.

Philo. Very well done indeed! I leave theſe two examples for practice.

Multiply	49997296	and	94171470
by	9	*by*	8
Anſwer		*Anſwer*	

Tyro. Pleaſe to give me an example or two to *multiply* by 12 in one line; for I know it is done much quicker, and it is as eaſy as to make two of it.

EXAMPLES *with twelves.*

Multiply	42576	and	994079	and	99807
by	12	*by*	12	*by*	12
Anſwer	510912	*Anſ.*	11928948	*Anſ.*	

Firſt, 12 times 6 is 72, that is, 2 and I carry 7; then 12 times 7 is 84, and 7 I carried is 91, that is 1 and I carry 9; then 12 times 5 is 60, and 9 I carried is 69, that is 9 and I carry 6; then 12 times 2 is 24, and 6 is 30, that is 0 and I carry 3; and *laſtly*, 12 times 4 is 48, and 3 is 51. And thus, by having the *table of twelves* perfectly by heart, every ſum will be eaſy to you.

Tyro. It is eaſy enough, I ſee: pleaſe now to ſhew me how you multiply by 2, 3, 4, or more figures.

Philo. This you will ſoon underſtand.

2. *Of multiplying by ſeveral Figures.*

Rule. When there are ſeveral figures in the *multiplier*, then you begin at the firſt figure in the units place, and multiply it through, or into every figure of the *multiplicand*, as you have done before. This being done, multiply every figure in the *multiplicand* by the ſecond figure of the *multiplier*; only obſerve to ſet the firſt figure of the ſecond row under the *tens place* of the firſt row; and thus you go on with the third figure in the *multiplier*, placing the *units place* of each ſucceeding row under the *tens place* of the row that is above it, till you have gone through every figure of the *multiplier*. Then draw a line under all the rows of figures, and add them together, and the ſum is the true *product* or *anſwer*.

Note, Be ſure you remember that you ſet your figures right under one another, or elſe in a large ſum you will be puzzled to add the work together.

EXAMPLES *with ſeveral figures.*

EXAMPLE I.	PROOF.
Multiply 89	*Multiply* 47
by 47	*by* 89
623	423
356	376
Anſwer 4183	*The ſame* 4183

In *Example* 1, I ſay, 7 times 9 is 63, that is 3 and I carry 6; then 7 times 8 is 56, and 6 I carried is 62, which I ſet down: ſo is the firſt line or row finiſhed. Then I take the ſecond figure of the *multiplier*, ſaying, 4 times 9 is 36, which 6 I ſet under the 2, or *tens place* of the firſt line, and carry 3; and then I ſay, 4 times 8 is 32, and 3 that I carried is 35, placing the 5 under the 6, and the 3 quite out towards the left hand. *Laſtly*, I add theſe up in order, as they ſtand, ſaying 3 is 3; then 6 and 2 is 8; again, 5 and 6 is 11, that is 1 and carry 1 to the 3 is 4.

To prove MULTIPLICATION.

It is a common way to prove *multiplication* by the croſs; but it is ſubject to ſo many errors, that, in ſhort, it is no proof at all to a learner, but rather a corruption. The beſt way therefore is this: take the *multiplicand*, and ſet it below, and the *multiplier* a-top; that is, change the *multiplicand* into the *multiplier*, and proceed as before directed, and if the product be the ſame as before, your work is entirely right. See the next examples wrought at large both ways.

EXAMPLE 2.		PROOF.	
Multiplicand	895	*Multiplicand*	798
Multiplier	798	*Multiplier*	895
	7160		3990
	8055		7182
	6265		6384
Product	714210	*The ſame*	714210

Firſt, I ſay, 8 times 5 is juſt 40; therefore I ſet down the 0, and I carry 4; then 8 times 9 is 72, and 4 I carried is 76, that is 6 and I carry 7; then 8 times 8 is 64, and 7 I carried is 71. Now I take the ſecond figure, ſaying, 9 times 5 is 45; which 5 I place under the ſecond figure, or *tens place* of the firſt line, and carry 4, ſaying, 9 times 9 is 81, and 4 is 85, which 5 I place under the figure 1, and carry 8 to the next figure, ſaying, 9 times 8 is 72, and 8 that I carried is 80. And now I come to the laſt figure of the *multiplier*, ſaying, 7 times 5 is 35, which 5 I place under the ſecond figure of the laſt line, and carry 3 to the next figure, ſaying, 7 times 9 is 63, and 3 I carried is 66, that is 6 and I carry 6; then 7 times 8 is 56, and 6 is 62. *Laſtly*, I add theſe up in order as they ſtand, and find the *product* 714210.

The proof of this example is worthy your obſervation, *Tyro*; for be the ſum ever ſo large, if you change the *multiplicand* into the *multiplier*'s place, and multiply right, you will find the *product* always the ſame.

Tyro. I ſee it plainly, ſir; and I could not have thought *multiplication* had been ſo eaſy.

Philo. Nothing eaſier, when the *table* is once well learned. I ſhall now give you two more examples, and leave the reſt undone for practice.

EXAMPLE 3.

Multiply 913876
by 8759

8224884
4569380
6397132
7311008

8004639884

EXAMPLE 4.

and 749076
by 1795

3745380
6741684
5243532
749076

1344591420

EXAMPLES *for Practice.*

Multiply 4567879
by 45769

Multiply 9567950
by 32796

☞ *Note*, Remember, *Tyro*, that when you multiply by ſeveral figures, that you always ſet the firſt figure of the ſecond line under the ſecond figure of the firſt line, and the firſt figure of the third line under the ſecond figure of the ſecond line: and thus go on, leaving one figure out towards the right hand every line, ſetting the next line one figure more towards the left hand, and every figure under one another in their proper place.

Tyro. I underſtand you well, ſir.

Philo. Then I will ſet you but one example more, which you may prove yourſelf.

Multiply 987654321
by 123456789

8888888889
7901234568
6913580247
5925925926
4938271605
3950617284
2962962963
1975308642
987654321

Anſwer 121932631112635269

PROOF.

Multiply 123456789
by 987654321

3. *Of Cyphers between the Figures, &c.*

The moſt difficult thing in this rule is, when the *multiplier* has ſome figures, ſome cyphers; but if you be careful to mind the work of an example or two, you will ſoon underſtand it, as I ſhall explain them in words.

EXAMPLE I.		EXAMPLE 2.	
Multiply	49657	*Multiply*	7564965
by	30705	*by*	5003007000
	248285		52954755000
	3475990		2269489500
	1489710		3782482500
Anſwer	1524718185	*Anſwer*	37847572849755000

Note, Pray obſerve, that you read the following inſtructions once or twice over, if you do not underſtand the work.

Firſt, I begin at the 5, and multiply all the top figures by it, as before: now, as the next figure of the *multiplier* is a cypher, it is of no ſignification to multiply by *that*, becauſe it will produce nothing but a line of cyphers: therefore I bring it down, that is, I ſet a cypher under the figure 8, and then begin to multiply by the 7, ſaying, 7 times 7 is 49, 9 and I carry 4; which 9 I ſet down in the ſame line, on the left hand of the cypher, and go on ſtill to multiply by the 7; then as the next figure is a cypher again, I ſet down a cypher under it, as I did before, leaving the 9, and the cypher which ſtands by it, in the laſt line, both ſtanding out towards the right hand. This being done, I only multiply by the 3, and ſet it in the ſame line, and add all up, and the work is done.

Again, in *Example* 2, there are three cyphers at the beginning of the *multiplier*, therefore I ſet three cyphers under the line, right under them; then multiply by the 7, as in all other ſums; ſaying, 7 times 5 is 35, &c. Then I come to two cyphers more in the *multiplier*, and therefore ſet two cyphers right under them, and then multiply by the 3, and place the product by the ſide of the two cyphers; then, as there are two cyphers, I again ſet down two cyphers, thus 00, under them, and then multiply by the 5, placing the product by the ſide of them. *Laſtly*, I add the ſum up as it ſtands, and it is done.

Note, Theſe examples are proved like the others, by ſetting the *multiplier* a-top, and the *multiplicand* under it.

More Examples for Practice.

Multiply	570965	and	71900072
by	2400500	*by*	5000960000

And now, *Tyro*, I ſhall finiſh this ſection with ſhewing you ſomething of *contractions*, or *compendiums*.

4. *Of* CONTRACTIONS.

When any number of figures are given to be multiplied by 10, 20, 30, 40, 80, 90, 120, 1200; then ſet the cyphers out, and multiply by the figure or figures, and place the *product* by the ſide of the cyphers, as before, gives the *anſwer*.

Multiply	275	and	3275	and	6759
by	20	*by*	90	*by*	1200
Anſwer	5500	*Anſ.*	294750	*Anſ.*	8110800

2. When you are to multiply by 1, the *anſwer* will be the ſame as the *multiplicand* itſelf is. If you are to multiply by 10, add 1 cypher to the *multiplicand*; if by 100, add two cyphers; if by 1000, add three cyphers. See the work two ways.

Multiply	1753		1753		1753
by	100		1000		10000
Anſwer	175300	*Anſ.*	1753000	*Anſ.*	17530000

Or rather thus:

Multiply 1753	*by*	1	*anſwer* the ſame,	*viz.*	1753
	by	10	add 1 cypher,	*anſ.*	17530
	by	100	add 2 cyphers,	*anſ.*	175300
	by	1000	add 3 cyphers,	*anſ.*	1753000
	by	10000	add 4 cyphers,	*anſ.*	17530000

And thus for as many cyphers as you pleaſe.

Tyro. The examples are quite plain and eaſy.

Philo. I am glad that you underſtand them; for now I ſhall ſhew you *that* which will ſerve you for all common buſineſs, in caſting up any ſort of goods; and pray be careful to mind it well; for there is not a more uſeful thing in all common arithmetic, it being a ſhort way of working the *Rule of Three* without *Diviſion*.

Queſtions

Queſtions *performed by* Multiplication.

Tyro. How are theſe queſtions performed?

Philo. By the following rule, *viz.*

Multiply the price by the given number, or quantity, and carry 1 for every 4, 12, and 20, as you do in *Addition of Money*, and 1 for every 10 in the pounds, as in *whole numbers.*

An example or two well explained will ſoon make it eaſy to you.

                                £. s. d.
Queſt. 1. What coſt 3 ells, at 0 - 5 - 3 an ell?
                                        3
£. 0 - 15 - 9

Here I multiply the price by the quantity, ſaying, 3 times 3 is 9 pence, which I place under the pence; and then I ſay, 3 times 5 ſhillings is 15, which I place under the ſhillings, and the anſwer is 15 ſhillings and 9 pence.

☞ You muſt remember, that 3 ells, at 5*s.* 3*d.* an ell, is the ſame as 3 yards, or 3 groſs, or 3 gallons, or any other name whatſoever; for it is only 3 times 5 ſhillings and 3 pence.

2. What come 5 groſs of } £. s. d.
any thing to, at } 0 - 6 - 8 a groſs
                                        5
£. 1 - 13 - 4

Here I multiply the price by 5, ſaying, 5 times 8 is 40 pence, (which is 3 ſhillings and 4 pence) therefore I ſet down 4 under the pence, and carry 3, and then 5 times 6 ſhillings is 30, and 3 I carried is 33 ſhillings, which is 1*l.* 13*s.* that is 13 and I carry 1; and then I ſay, 5 times 0 is 0, but 1 is 1.

3. How much does 7 times 8 ſhillings and 9 pence
amount to? Or, } £. *s.* *d.*
What coſt 7 reams of paper, at } 0 - 8 - 9 a ream?
7

£. 3 - 1 - 3 *Anſ.*

Here I ſay, 7 times 9 is 63 pence, which is 5 ſhillings and 3 pence, that is 3 and I carry 5; then 7 times 8 is 56 ſhillings, and 5 I carried is 61, that is 3*l.* 1*s.* or, which is the ſame, it is 3 twenties, and 1 over; therefore I ſet 1 under the ſhillings, and carry 3 to the pounds, ſaying, 7 times 0 is 0, but 3 is 3; ſo is the anſwer 3*l.* 1*s.* 3*d.*

Note, Though I have ſet cyphers in the place of pounds in theſe examples, and have alſo ſet £. *s.* *d.* over the ſums, yet it is better to leave out the cyphers, and more practicable to make only a great £. before the pounds, as in the following examples.

4. What coſt 9 gallons of brandy, or any thing elſe,
at——————£.——8 - 3$\frac{1}{4}$ a gallon?
9

£. 3 - 14 - 5$\frac{1}{4}$

Here I multiply the price by 9, beginning at the farthings, ſaying, 9 farthings is 2 pence farthing, that is 1 farthing, and I carry 2 pence; then 9 times 3 is 27 pence, and 2 pence I carried is 29 pence, which is 2 ſhillings and 5 pence; therefore I ſet down 5 under the pence, and carry 2, ſaying, 9 times 8 is 72 ſhillings, and 2 I carried is 74. Now 74 ſhillings is 3*l.* 14*s.* therefore, as there is nothing in the pounds to multiply, I ſet down 3*l.* 14*s.* *viz.* the 14 under the ſhillings place, and 3 towards the left hand.

Tyro. This is very pretty, and very eaſy: pleaſe to try me with an example.

Philo. There is no doubt but you will do it.

5. A Gentleman gave ten poor Widows three half crowns a piece: how much did he give in all? or thus, What coſt 10 buſhels of any thing, at £. — 7 — 6
a buſhel? 10

£. 3 — 15 — 0

Tyro. I ſet down 3 half crowns, that is 7*s.* 6*d.* and multiply it by 10, ſaying, 10 times 6 is 60 pence, that is juſt 5 ſhillings; therefore I ſet down nothing (0) and carry 5; then I ſay, 10 times 7 is 70, and 5 I carried is 75 ſhillings, which is 3*l.* 15*s.* So is the anſwer, £. 3 - 15.

6. What comes 12 months wages to, at } £. 1 - 8 - 6¼ a month?
12

Anſ. 17 - 2 - 3

Or how much is 12 times £. 1 - 8 - 6¼?

Here I ſay, 12 farthings is 3 pence, that is 0 and I carry 3; then 12 times 6 is 72, and 3 I carried is 75 pence, which is 6*s.* 3*d.* I therefore ſet down 3, and carry 6; then I ſay, 12 times 8 is 96 ſhillings, and 6 I carried is 102 ſhillings, which is 5*l.* 2*s.* ſet down 2, and carry 5; then I ſay, 12 times 1 is 12, and 5 I carried is 17*l.* So is the anſwer £. 17 - 2 - 3.

2. *Of double Figures in the Shillings.*

When you come to double figures, ſuch as 14, 17, 18, or the like, multiply them like *whole numbers*, and then caſt out the twenties, that is, count how many times 20 you can have in the number, and it is done. There are ſeveral other ways I ſhall ſhew you, and always take *that* which appears eaſieſt to you, till perfect.

7. What coſt five ſheep, at £. 1 - 17 - 6 each?
Or, What is 5 times £. 1 - 17 - 6
5

Anſ. £. 9 - 7 - 6

Here I ſay, 5 times 6 is 30 pence, or 2*s.* 6*d.* that is 6 and I carry 2; then I multiply the whole 17 by 5, ſaying, 5 times 7 is 35, and 2 I carried is 37, 7 and I go 3; then 5 times 1 is 5, and 3 is 8, that is 87 ſhillings, which is 4*l.* 7*s.* that is 7 and I carry 4; then 5 times 1 is 5, and 4 is 9.

Or thus:

I multiply firſt the 7 by the 5, ſetting down the product on a ſlate or piece of paper, ſaying, 5 times 7 is 35, and 2 I carried is 37 ſhillings, or 1*l.* 17*s.* then I ſay, 5 times 10 is 50 ſhillings, or 2*l.* 10*s.* and add this to 1*l.* 17*s.* it makes 4*l.* 7*s.* as before. See the next example.

8. What coſt 7 gallons at £. 1 - 15 - 9¼ a gallon ?
7

£. 12 - 10 - 4¾

Here I ſay, 7 farthings is 1 penny 3 farthings, therefore I ſet down ¾ and carry 1; then 7 times 9 is 63, and 1 is 64 pence, that is 5*s.* and 4*d.* 4 and I carry 5; then 7 times 5 is 35, and 5 is 40, 0 and I carry 4; 7 times 1 is 7, and 4 is 11, that is 110 ſhillings in all, which is 5*l.* 10*s.* that is 10 and I carry 5; and *laſtly*, 7 times 1 is 7, and 5 is 12.

Or thus, 7 times 5 is 35, and 5 is 40 ſhillings, that is 2*l.* which I ſet down any where on a ſlate; then I ſay, 7 times 10 ſhillings is 3*l.* 10*s.* Now 3*l.* 10*s.* and 2*l.* is 5*l.* 10*s.* as before. Again,

9. What coſt 12 quarters of malt, at £. 1 - 14 - 6
a quarter? 12

Anſ. 20 - 14 - 0

Here I ſay, 12 6 pences is 6 ſhillings, that is 0 and I carry 6; then 12 times 4 is 48, and 6 is 54, 4 and I carry 5; 12 times 1 is 12, and 5 is 17; that is 174 ſhillings, which is 8*l.* 14*s.* that is 14 and I carry 8; then 12 times 1 is 12, and 8 is 20 pounds. Or,

By the ſecond way, 12 6 pences is 6 ſhillings, as before, 0 and I carry 6; then 12 times 4 is 48, and 6 is 54, that is 2*l.* 14*s.* then 12 times 10 ſhillings is 6*l.* Now 6*l.* and 2*l.* 14*s.* is 8*l.* 14*s.* as before, that is 14 and I carry 8; then 12 times 1 is 12, and 8 is 20.

Tyro. I underſtand both the ways very well.

Philo. Take which you think is eaſieſt, they both anſwer the ſame end.

Tyro. But ſuppoſe I have a larger quantity than 12, how muſt I multiply the price by that number?

Philo. By the following rule.

5. *When there are two Figures to multiply by.*

Rule. When the given quantity is more than 12, and contains any ſuch numbers as can be found in the *Multiplication table*, then find any two numbers, which when multiplied together will make the given number, and then multiply the given price by any one of thoſe figures, and that product multiply by the other number, and that product is the anſwer. Thus, ſuppoſe I am to multiply by 15, I find 3 times 5 is 15; therefore I multiply by the 3 firſt, and ſet down the product; then I multiply this product by 5, and that gives me the anſwer for 15, becauſe 3 times 5, or 5 times 3 make that number. Again, ſuppoſe I were to multiply by 24, I find 4 times 6 is 24; therefore I firſt multiply by 4, and then multiply that product by 6, which is the anſwer: or otherwiſe, as 3 times 8 is 24, I may therefore multiply firſt by 3, and then by 8. So if the number be 63, I find 7 times 9, or 9 times 7 is 63; therefore, I multiply the price by any one of theſe figures, and that product I multiply by the other for the true anſwer.

10. What coſt 15 ells of holland, at £. - 7 - 6 an ell?
Here 3 times 5 is 15; multiply firſt by 3

The price of 3 ells —— £. 1 - 2 - 6
Multiply by 5 5

Price of 15 £. 5 - 12 - 6 *Anſ.*

Work at Length.

Firſt I ſay, 3 ſix-pences is 1*s.* 6*d.* that is 6 and I carry 1; then 3 times 7 is 21, and 1 I carried is 22 ſhillings, which is 1*l.* 2*s.* So is the price of 3 ells, 1*l.* 2*s.* 6*d.* Now I multiply this 1*l.* 2*s.* 6*d.* by 5, (becauſe 5 times 3 is 15) ſaying, 5 times 6 is 30 pence, is 2*s.* 6*d.* or 5 ſix-pences is 2*s.* 6*d.* that is 6 and I carry 2; then 5 times 2 is 10, and 2 is 12, which I ſet down. *Laſtly*, I ſay, 5 times 1 is 5; ſo the anſwer for 15 ells, at 7*s.* 6*d.* an ell, is £. 5 - 12 - 6.

11. What coſt 24 chaldrons of coals, at	£. 1	11	6	a chaldron?
4 times 6 is 24, firſt multiply by			4	
The price of 4 chald.	6	6	0	
6			6	
The price of 24 chald.	£. 37	16	0	*Anſ.*

Proved another way	£. 1	11	6	
3 times 8 is 24, multiply by			3	
Price of 3 chald.	4	14	6	
Multiply by 8			8	
Price of 24 chald.	£. 37	16	0	as above.

12. What coſt 35 ſheep, at	£. 1	15	7	each?
5 times 7 is 35, multiply firſt by			5	
Price of 5	8	17	11	
7			7	
Price of 35	£. 62	5	5	*Anſ.*

13. What coſt 48 load, at	£. 3	10	6	a load?
6 times 8 is 48, multiply by			6	
Price of 6	£. 21	3	0	
Multiply by 8			8	
Price of 48	£. 169	4	0	

14. What coſt 72 pieces of Holland, at	£. 2	3	5	a piece?
6 times 12, or 12 times 6 is 72, by			12	
Price of 12	26	1	0	
Multiply by 6			6	
Price of 72	£. 156	6	0	*Anſ.*

15. What coſt 108 quartern loaves, at } £. 0 - 0 - 5¾ a piece?
12 times 9 is 108, multiply by 12

Price of 12 — 0 - 5 - 9
Multiply by 9 — 9

Price of 108 — £. 2 - 11 - 9

Note 1. I have here indulged you with cyphers, becauſe I would do every thing that is eaſy to your underſtanding; but really, *Tyro*, it is better without them. Set down now 5 pence 3 farthings any where.

5¾
12

- 5 - 9
9

£. 2 - 11 - 9 *Anſwer.*

Note 2. This is the only way, if you have a mind to do things quick, and off hand; for though there be a form in ſome ſchools to the contrary, and you may hitherto have been inſtructed in that way; yet, as I obſerved before, when you come to do a ſum, you are not bound to ſet it down in the very form you were taught at ſchool; for while you are doing *that*, another will anſwer the queſtion over and over.

Tyro. I underſtand you, ſir, very well, and thank you for your care; but it is only uſe, as you obſerved; for I think one full as eaſy as the other, and I grant it is much better for the quick diſpatching of buſineſs.

16. What comes the cloathing of 144 ſoldiers to, at } £. 3 - 12 each man?
12 times 12 is 144, multiply by 12

12 coſt — 43 - 4
12 again by — 12

144 coſt — £. 518 - 8 *Anſ.*

Tyro. You need not give me any more examples; but pray, ſuppoſe the quantity, or given number, be ſuch as does not fall under, or cannot be found in the *Multiplication table*, ſuch as 17, 26, 38, 59, or the like; how then?

Philo. This is as eaſy as the other, as appears by the following rule.

4. *Of Numbers that are not to be found in the* Multiplication Table, *and how to work by them.*

Rule. When the given number does not fall under the common courſe of the table, ſuch as 17, 38, 59, or the like; then take any two figures that will come the neareſt to the number (but not exceeding it) and work with them as in the former examples, and then add the price to that product as many times as there are odd numbers, and the work is done.

We will give you examples of 17, 38, and 59.

17. What coſt 17 groſs of corks, at £. - 10 - 6½ a groſs?
times 4 is 16, and 1 is 17. Mult. by 4

Price of 4 is 2 - 2 - 2
4 4

Price of 16 is 8 - 8 - 8
Add the price of 1 groſs, *viz.* 10 - 6½

17 is £. 8 - 19 - 2½ *Anſ.*

18. What coſt 38 loads of hay, at £. 1 - 11 - 6 a load?
6 times 6 is 36, and 2 is 38. Mult. by 6

Price of 6 is 9 - 9 -
6 6

Price of 36 is 56 - 14 -
Mult. the price 1*l.* 11*s.* 6d. by 2 gives 3 - 3 add

Price of 38 is £. 59 - 17 - *Anſ.*

19. What is the value of 59 ports, at £. 1 - 16 - each?

7 times 8 is 56, and 3 is 59. Mult. by			7	
Value of 7 is		12 -	12 -	
8	by		8	
Value of 56 is		100 -	16 -	
Then multiply 1*l.* 16*s.* by 3 is		5 -	8 -	add
Value of 59	£.	106 -	4 -	

This may be done another Way.

As you ſaid before, 7 times 8 is 56, and 3 added make 59. So now you may ſay, 6 times 10 is 60; and then take or ſubtract the value of one piece out of that product, and the anſwer will be the ſame as 59.

1 port is	£.	1 -	16 -	
10 times 6 is 60, firſt	by		6	
Value of 6 is		10 -	16	
10			10	
Value of 60 is		108 -	-	
Subtract 1 piece, *viz.*		1 -	16 -	ſubtract
59	*Anſ.*	106 -	4 -	as above

Note 1. As ſome boys learn ſooner by one method than another, ſome maſters find it eaſier to teach them to calculate by even tens, and add the odd numbers after. Thus, if it were 43, then multiply by 10, then by 4, gives 40, and then add the 3 odd numbers. So 65 is 10 × 6 + 5 = 65, and thus for any numbers.

Note 2. If you are perfect in what has already been ſhewn you, it will be very eaſy to perform any ſum in common arithmetic, relating to buſineſs, not only within the compaſs of the table, but in much larger numbers. As for inſtance; ſuppoſe it was required to tell the value of 1000 moidores; or what it will coſt to cloath 1000 men, at 1*l.* 7*s.* a man? Here 10 times 10 make 100, and 10 times 100 makes 1000. Multiply therefore 1*l.* 7*s.* by 10; then that product by 10; and this laſt product by 10 will give the anſwer, *viz.* £. 1350.

QUESTIONS *undone for practice.*

1. What comes 33 dozen of candles to, at 4*s.* 9*d.* a dozen? *Anſwer* £. 7 - 16 - 9. Multiply by 3, and then by 11.

2. How much is 46 piſtoles, at 17*s.* 6*d.* each? or what coſt 46 pieces of *Iriſh*, at 17*s.* 6*d.* a piece? *Anſwer* £. 40 - 5. Multiply by 5, then by 9, and add 17*s.* 6*d.* more for the odd 1.

3. What coſt 63 barrels, at £. 1 - 5 - 9 a barrel? *Anſ.* £. 81 - 2 - 3.

4. What comes 49 months ſalary to, at 3 guineas a month? *Anſ.* £. 154 - 7.

5. What comes 105 gallons of rum to, at 7*s.* 6*d.* ½ a gallon? *Anſ.* 39 - 11 - 10½. 10 times 10 make 100, and then multiply 7*s.* 6*d.* ½ by 5, the odd 5 gallons, and add it to the laſt product.

6. If I ſpend 1*d.* ¾, or 7 farthings a day, how much is that a year, allowing 365 days? *Anſ.* £. 2 - 13 - 2¾.

Firſt, 10 times 10 make 100; then multiply the anſwer of 100 by 3, it gives you the expences of 300 days, *viz.* 2*l.* 3*s.* 9*d.* Now there are but 65 days behind; therefore ſet down 7 farthings in another place, and multiply it by 8, and that product multiplied by 8 again, makes 64, and then add once 1*d.* ¾ for the odd day, gives 9*s.* 3*d.* ¾ for the 65 days, which added to the 300 days, gives £. 2 - 13 - 2¾. *Secondly*, or thus, which is ſhorter, 11 times 11 is 121; then multiply the product of 121 by 3, gives 363, and then add 2 times 1*d.* ¾, *viz.* 3*d.* ½ to that product, gives £. 2 - 13 - 2¾, as before.

As I have added the anſwers to theſe queſtions, I hope, *Tyro*, you will try to prove them at large: for if you mind and make yourſelf maſter of this rule, you will be able to caſt up any common thing as quick, or quicker than by any other method, and with far greater eaſe.

As for *croſs multiplication*, *viz.* multiplying money by money, or feet and inches by feet and inches, it is better let alone for the preſent; therefore we will proceed to *Diviſion.*

DIALOGUE V.

SECTION I.

Of DIVISION.

Tyro. WHAT is *Diviſion*, and what does it teach?

Philo. *Diviſion* is juſt the reverſe of *multiplication*; for as any ſum is encreaſed as many times as the figure you multiply by; ſo in *diviſion*, the number is decreaſed, or divided into as many parts as the value of the figures you divide by.

Tyro. What is to be learned or obſerved in this rule?

Philo. There are four things very neceſſary to be known in *diviſion*, *viz.*

Firſt, The *Dividend*, which is the ſum given to be divided.

Secondly, The *Diviſor*, or the number you are to divide by.

Thirdly, The *Quotient*, or *Anſwer*, which ſhews you how many times the *Diviſor* is contained in the *Dividend*; or into how many parts the *Dividend* is divided.

Fourthly, The *Remainder*, which is a fractional part of the *Quotient*; but this does not concern you as yet.

Tyro. Am I to get theſe by heart?

Philo. You are not bound to get them juſt word for word; but you ſhould underſtand well what the firſt 3 mean.

Tyro. Be ſo kind, ſir, as to explain them a little more for me.

Philo. Obſerve then: let us take any two numbers, ſuppoſe 24, and 6; now 24 is the *Dividend*, and 6 is the *Diviſor*. Then I aſk how many times 6 I can have in 24, and the anſwer is 4; which 4 is called the *Quotient*. So alſo, ſuppoſe it was required to divide 108 by 12 into 12 parts, then every part will be 9; for 12 times 9 is 108. Now 108 is the *Dividend* or ſum to be divided; 12 is the *Diviſor*, or what you divide by, and 9 is the *Quotient*.

Tyro. Now, ſir, I apprehend you quite well.

Philo. Then I will proceed to ſome examples in ſingle figures; but pray obſerve the following rule.

1. *Of dividing by ſingle Figures in one line only.*

Rule. Firſt aſk how many times the *Diviſor* is contained in the firſt figure of the *Dividend*, and if the *Diviſor* be larger than the firſt figure in the *Dividend*, then ſeek how many times you can have it in the firſt two figures in the *Dividend*, and ſet the figure down accordingly; and if any thing remains from the firſt figure in the *Dividend*, carry it to the ſecond; and if any thing remains in the ſecond figure, carry it to the third; remembering always in this ſhort *Diviſion*, that if one remains you call it 10, if two remain you call it 20, if 5 50, and ſo on, carrying the remainder of one figure to another in your mind.

Note, To make the work both ſhorter and eaſier, remember that 2's is read *two's*, 3's *three's*, 5's is *five's*, 12's is *twelve's*, and ſo for any other figure: thus, the 7's in 14 is read thus, the *ſevens* in 14; and the 6's in 24, is the *ſixes* in 24; which is the ſame as if I ſhould aſk, how many *ſixes* can I have in 24, but only ſhorter and more convenient.

An example or two will, with care, make it familiar to you.

Ex. 1.	*Dividend.*	Ex. 2.	*Dividend.*
Diviſor	3)39	*Diviſor*	4)168
Quotient	13 *Anſ.*	*Quotient*	42 *Anſ.*
	3		4
Proof	39	*Proof*	168

Now obſerve: In *Ex.* 1, I aſk how many *three's* I can have in 3; or I ſay the 3's in 3 is once; therefore I ſet down 1 under the 3 in the *dividend*, and as there remains nothing over, I aſk how many 3's I can have in 9; or ſay, the 3's in 9 is 3 times 3, and nothing over; therefore I ſet down 3 under the 9, and it is done. Again,

In *Ex.* 2, I ſay, the 4's in 1 I can't have; but taking the next figure to it, *viz.* 6, I ſay the 4's in 16 is juſt 4 times, therefore I ſet down 4 under the 6 in the *dividend*, and as there is nothing remains, I only ſay, the 4's in 8 is twice, therefore I ſet down 2 under the 8, and it is done. Now to prove it I multiply 42, the *quotient*, by 4, the *diviſor*, and find it 168, like the *dividend*.

Ex. 3.	*Dividend.*	Ex. 4.	*Dividend.*
Diviſor	8) 37192	*Diviſor*	9) 245052
Anſwer	4649	*Anſwer*	27228
	8		9
Proof	37192	*Proof*	245052

Now obſerve, *Tyro*, in *Ex.* 3, I divide by 8, ſaying, the 8's in 3 I can't, but the 8's in 37 is 4 times 8 is 32, and 5 over; I therefore ſet down 4 under the 7, and carry 5 to the next figure, which is 1, which I now call 51; (for what you carry from one figure you muſt always place before the next figure) then I ſay, the 8's in 51 is 6 times 8 is 48, and 3 over; which 3 I now carry to the 9, and it is 39; therefore I ſay, the 8's in 39 is 4 times 8 is 32, and 7 over; this 7 I now place before the 2, and it is 72; then I ſay, the 8's in 72 is juſt 9 times, and the work is done. *To prove it*, I multiply the *quotient* or anſwer by the *diviſor* 8, and find the *product* the ſame as the *dividend*. In *Ex.* 4, I ſay, the 9's in 2 I can't, but the 9's in 24 is 2 times, or *twice* 9 is 18, and 6 over, which 2 I place under the 4, and carry 6 to the next figure, which is 5, and call it 65; then I ſay, the 9's in 65 is 7 times 9 is 63, and 2 over, which 2 I place before the cypher (0) and it is 20; then I ſay, the 9's in 20 is *twice* 9 is 18, and 2 over, which I carry to the 5, and it is 25; then I ſay, the 9's in 25 is *twice* 9 is 18, and 7 over, which I ſet before the laſt figure 2, and it is 72; then I ſay, the 9's in 72 is juſt 8 times. *To prove it*, I multiply the *anſwer* by 9, and the *product* will be the ſame as the *dividend*.

EXAMPLE 5.

Divide by 7)417296
Anſwer 59613 - 5*
7
Proof 417296

EXAMPLE 6.

Divide by 9)9471636
Anſwer 1052404
9
Proof 9471636

* Here, in *Example* 5, there is 5 remains at laſt ; therefore I ſet it at the end of the anſwer, parting it with a ſtroke thus, - 5 ; and when I prove the work, I multiply by 7, and take the remaining 5 in, ſaying, 7 times 3 is 21, and 5 is 26, 6 and I carry 2, &c.

EXAMPLE 7.

8)716206
Anſwer 89525-6
8
Proof 716206

EXAMPLE 8.

5)12631908
Anſwer 2526381-3
5
Proof 12631908

More Examples for Practice.

7)697220716
9)407217943

Tyro. I underſtand what you have ſhewn me very well ; but pray, before you come to long *Diviſion*, give me an example at large to divide by *twelve* the ſhort way.

Philo. I will : let it be required to divide 1479908 by 12, I ſet it down thus :

EXAMPLE 11.

12)1479908
123325-8

EXAMPLE 12

12)59904965
4992080-5

Here I divide by 12, ſaying, the 12's in 14 is *once* 12, and 2 over, and this 2 I carry to the 7, and it is 27 ; then I ſay, the 12's in 27 in *twice* 12 is 24, and 3 over, that is 39; then I ſay, the 12's in 39 is 3 times 12 is 36, and 3 over, that is 39 again; therefore I ſet down another 3, and carry the 3 that is over to the next figure, which is a cypher, calling it 30; then I ſay, the 12's in 30 is *twice* 12 in 24, and 6 over, which is 68; now the 12's in 68 is 5 times 12 is 60, and 8 over, which I place after the ſum, thus, -8, and it is done.

In *Ex.* 12, I ſay, the 12's in 5 I can't, but the 12's in 59 is 4 times 12 is 48, and 11 over, which 11 carried to, or joined to the next figure 9, is 119; then I ſay, the 12's in 119 is nine times 12 is 108, and 11 over again, which I now carry to, and join to the next figure 0, and call it 110; then I ſay, the 12's in 110 is 9 times, and 2 over, which 2 I join to, or carry to the 4, and it is 24; now the 12's in 24 is juſt *twice*, and nothing over; therefore I now begin a-freſh, at the 9, ſaying the 12's in 9 I can't, but the 12's in 96 is juſt 8 times. *Laſtly*, I ſay, the 12's in 5 I can't have; therefore I ſet down a cypher under the laſt figure 5, and drawing a ſhort line, ſet the 5 that remains after it thus, -5.

Now *to prove* it, I multiply back by 12, and take in the 5, ſaying, 12 times 0 is 0, but 5 is 5; then 12 times 8 is 96, 6 and I carry 9, *&c.* till I go through the whole.

☞ *Note*, *Multiplication* is an infallible proof for *Diviſion*; for if you multiply the *quotient* by the *diviſor*, you will have the ſame figures as are in the *dividend*, always remembering to take in the remainder with the firſt figure you begin to multiply.

Tyro. I humbly thank you, ſir, I am quite ſatisfied with what you have ſhewn me; and now, if you pleaſe, I ſhall be obliged to you to ſhew me how to divide by ſeveral figures.

Philo. You will ſoon learn it with care; you muſt note there are three or four ways to work *Diviſion*; but as my intent is not for curioſity, but improvement, I ſhall only ſhew you that method which is moſt *natural* and *practicable*; you may at any time learn the reſt.

2. *Of*

2. *Of dividing by 2, 3, or more Figures.*

Rule. Firſt, *ſeek*, or aſk how many times the figures in the *diviſor* are contained in the ſame mumber of figures in the *dividend*, and put that figure in the *quotient*. *Secondly*, *multiply* now the *diviſor* by the ſaid figure in the *quotient*, and place it under thoſe figures in the *dividend* that you began to work with, always obſerving, that the product be not larger than the figures in the *dividend*; for if they are, you muſt rub out, or cancel the figure in the *quotient*, and put one of a leſs denomination. *Thirdly*, this being done, *ſubtract* now the *product* frow that part of the *dividend* it ſtands under, and to the remainder bring down the next figure in the *dividend*, placing or joining it to the laſt figure of the *remainder*. Then *ſeek* how many times the *diviſor* is contained in theſe figures; then multiply the *diviſor* by the ſaid figure; then ſubtract again; and *laſtly*, bring down the next figure in the *dividend*, as before; and thus proceed till you have no more figures in the *dividend* to bring down, and the work is done.

☞ *Note* 1. Every time you *ſubtract*, obſerve whether the *remainder* be larger than the *diviſor*; for if it be, you muſt put a larger figure in the *quotient*.

Note 2. Whenever you take a figure down from the *dividend*, and join it to the *remainder*, and that is ſtill leſs than the *diviſor*; then always put a cypher in the *quotient*, and bring down another figure in the *dividend*.

An example or two at large will make it eaſier.

EXAMPLE 1.

```
                 Dividend
Diviſor 15)19260(1284 quotient or anſwer
           15                Quotient 1284
          ———              Multiply by  15 diviſor
           42                        ————
           30                         6420
          ———                         1284
           126                       ————
           120              Product 19260 dividend.
          ————
             60
             60
           ———
              0
```

Now obſerve; having two figures in the *diviſor*, I aſk how many times they are contained in the two firſt figures of the *dividend*, (*viz.* 19) and I find it *once*; therefore I ſet 1 in the *quotient*. *Secondly*, I multiply the *diviſor* 15 by 1, ſaying, *once* 5 is 5, *once* 1 is 1, and place it under the 19. Then, *thirdly*, *ſubtract* 15 from 19, and there remains 4; and *laſtly*, I bring down the next figure in the *dividend*, (*viz.* the 2) and join it by the ſide of the remainder 4, and it is 42; and now I begin as at the firſt, and aſk how many times 15 are contained in 42, and find it *twice*; therefore I ſet down 2 in the *quotient*; then I multiply the *diviſor* 15 by 2, which is 30, and place it under 42; this done, I *ſubtract* 30 from 42, and there remains 12; and then again, I bring down the next figure of the *dividend* (*viz.* 6) and place it by the ſide of 12, and it is 126. Then I aſk how many times 15 I can have in 126, and find it 8 times; therefore I put an 8 in the *quotient*, and multiply 15 by it, which is 120, which I place under 126. Then I *ſubtract* 120 from 126, remains 6, and bring down the laſt figure in the *dividend*, which is a cypher (0) and it makes 60; then I ſeek how many times 15 I can have in 60, and find it four times; then I multiply 15 by 4, and find it juſt 60, which I place under the other 60, and the work is done.

RULE 2.

Note 1. When there are ſeveral figures in the *diviſor*, it is eaſier for a learner to aſk how many times the firſt figure of the *diviſor* is contained in the firſt figure of the *dividend*, and place the times in the *quotient*; then multiply the whole *diviſor* by the *quotient* figure, and if the *product* be more than the figures which belong to the *dividend*, you muſt make trial of a leſs figure, and put it in the *quotient*.

Note 2. If the firſt figure of the *diviſor* be larger than the figure in the *dividend*, then take 2 figures in the *dividend*, and ſeek how many times the firſt figure of the *diviſor* is contained in them.

Note 3. You muſt remember, that in making trial how often the firſt figure in the *diviſor* is contained in two figures of the *dividend*, it will ſometimes appear to be 10 or 12 times; but obſerve, it never can be above 9 at moſt; and oftentimes not ſo many as it appears to be.

The ſame example farther demonſtrated.

Let it be required to divide 19260 by 15?

Firſt, I ſet the *dividend* down on a ſlate, and make a couple of crooked lines at the ends of it, in the firſt of which I place the *diviſor*, thus, 15)19260(and the other is to place the *quotient* in.

Secondly, I aſk how many times the firſt figure of the *diviſor* is contained in the firſt figure of the *dividend*, and find it *once*, therefore I place a 1 in the *quotient*, and multiply the whole *diviſor* by it, and place the product under the two firſt figures of the *dividend*, and ſubtract it therefrom, and it will ſtand thus:

Second Work.

15)19260(1
15·

Remains 42

Thirdly, To this remainder 4 I bring down the next figure, *viz.* 2, (always making a dot under the figure I bring down) and it is 42; then I aſk how often the firſt figure 1 in the *diviſor* is contained in 4, and it is 4 times; but, upon trial, I find 4 times 15 is 60, therefore as 60 is more than 42, I muſt take a leſs figure; I therefore make trial of a 2, and find twice 15 is 30, which I place under 42, and ſubtract it, and there remains 12, which ſtands thus:

Third Work.

15)19260(12
15··

42
30

Remains 126

Fourthly, I now make a dot under the 6, and bring it down by the ſide of the 12, and it is 126; then I aſk how many of the firſt figure of the *diviſor* I can have in the two firſt figures of the *dividend*, and find it 12 times; but according to *note* 3, it never goes above nine times; therefore I multiply 15 by 9, and it is 135; now I can't take 135 out of 126, therefore 9 times is too much, and I make trial of a leſs figure, to wit, 8, which I put in the *quotient*, and multiply 15 by it, which is 120, and place it under 126, and there remains 6, which ſtands thus:

Fourth Work.

15)19260(128
15···
―――
42
30
―――
126
120
―――
6

Laſtly, I make a dot under the cypher (0) and bring it down by the ſide of the 6, thus, 60; then I aſk how many times the firſt figure of the *diviſor* is contained in 6, or the *ones* in 6 is 6 times; but, upon trial, I find it will go but 4 times; therefore I place a 4 in the *quotient*; and multiplying 15 by it, find it to be 60, which I place under the other 60, and there remains 0, and the work is done, as under.

Laſt Work.

Diviſor 15)19260(1284 *quotient*
15···
―――
42
30
―――
126
120
―――
60
60
―――
0

Proof.

1284 *quotient*
15 *diviſor*
―――
6420
1284
―――
Product 19260 *dividend*

☞ *Note*, The reaſon of making dots under every figure you take down, is becauſe you may not miſtake which figure comes next in courſe; but when you are quite perfect, you need not trouble yourſelf with them.

Tyro. This is a plain demonſtration, and I ſee now the manner of working *diviſion*, though, I own, I am not perfect yet.

Philo. I ſhall give you an example or two more then, and ſhew you at the ſame time how to prove it by *addition*.

EXAMPLE 2.

Divide by 375)24172196(64459 *Anſwer*

	*2250····	
	1672	64459
	*1500	375
	1721	322295
	*1500	451213
		193377
	2219	
	*1875	24172125
		71 add *rem.*
	3446	
	*3375	24172196 *proof*
Remains	*71	
Proof	24172196	

The PROOF.

This example is proved the ſame as the laſt, by multiplying the *quotient* by the *diviſor*, and afterwards adding the *remainder* to it.

PROOF *by* ADDITION.

Though *multiplication* be an infallible proof of *diviſion*, yet in large ſums, *addition* is much ſhorter and eaſier, and when the work is right, is as infallible as the other. If indeed it be objected, that a boy may *vamp*, or alter the figures (as in proving *multiplication* by the croſs) in order to make the ſum come right, there is the ſame reaſon to ſuppoſe (without his Maſter's inſpection) that he may alter his *multiplication* ſum, when he comes to add it up, that it may fall right with the *dividend*. Beſides, as in the very work of every *Diviſion* ſum, the *diviſor* is naturally multiplied into every figure of the *quotient*, what need it to be done again? And I perſuade myſelf, that thoſe maſters, that have made uſe of this method of proving *Diviſion*, will acknowledge, that it is not only much eaſier to the ſcholar, but alſo much more improving; becauſe he muſt ſet his figures in order, right under one another, or elſe he will be puzzled to add the ſum up; he cannot therefore avoid improving himſelf in ſome meaſure by this method.

To prove Diviſion *by* Addition.

Rule. Add the remainder of all the different products of the *diviſor* together, in order as they ſtand, and their ſum will be the ſame as the *dividend*. Or thus: Add the remainder (if any) and all the lower lines together in order as they ſtand, and you will find their ſum the ſame as the *dividend*, if the work be right.

Note. In *Ex*. 2, I have made ſtars (thus *) againſt thoſe figures which are to be added together; which you ſee is the lower row of the two; for the top row is never added.

Two Examples, with their Proofs.

EXAMPLE 3.

```
Divide by 5267)821695074(156008 anſwer
            *5267 ....
            ----------
            29499
           *26335
            ----------
             31645
            *31602
            ----------
               43074
              *42136
            ----------
Remains          *938
            ----------
Proof       821695074
```

Ex-

EXAMPLE 4.

Divide by 9758)94076257(9640 *anſwer*
*87822 · · ·

62542
*58548

39945
*39032

Remains *9137

Proof 94076257

Here, in the firſt example, I take all the lower lines of the two, againſt which this mark (*) is placed, and beginning at the remainder, I ſay, 8 and 6 is 14, 4 and I carry 1 to 3 is 4, and 3 is 7; then 9 and 1 is 10, that is 0 and I carry 1 to 2 is 3, and 2 is 5; then 4 and 5 is 9; then 6 and 3 is 9, and 7 is 16, 6 and I carry 1 to 1 is 2, and 3 is 5, and 6 is 11, that is 1, and I carry 1 to 3 is 4, and 6 is 10, and 2 is 12, that is 2 and carry 1 to 2 is 3, and 5 is 8. And thus you may proceed to prove the other example.

Tyro. I confeſs I could not have thought it had been ſo eaſy; and it is (in effect) proving it by Multiplication, as you obſerved.

Philo. I am glad you underſtand it; and I hope you will take ſuch care as to have no occaſion to prove the work at all. Perſons in buſineſs, *Tyro*, cannot go through theſe forms; if they ſuſpect they have done wrong, they look over the work a ſecond time, and that is a ſufficient proof in general.

Of CONTRACTIONS.

Tyro. What is the uſe of contractions?

Philo. When the diviſor conſiſts of ſeveral cyphers after a figure or figures, then cut them all off, or ſeparate them from the figures with a daſh of your pen or pencil; and alſo remember at the ſame time to cut off as many cyphers or figures in the dividend; then work the ſum as if ſuch cyphers never had been there at all, and you will have the ſame anſwer.

Ex. 1.
1|000)9250|000
9250 *Anſ.*

Ex. 2.
4|00)5476|00
1369 *Anſ.*

Ex. 3.
12|00)54762|00
Anſ. 4563-6

Here cut off all the cyphers in the diviſor, and as many cyphers in the dividend, and divide only by the ſingle figures, and if any thing remains, I ſet it after it. As in example 3, there is 6 remains, which I ſet after the anſwer, thus, -6.

Tyro. This is eaſy enough; and now, if you pleaſe, I ſhould be glad to know what you mean by *Diviſion of Parts.*

SECTION I.

DIVISION *of Parts.*

Philo. D*IVISION of Parts* is the dividing by any two ſingle figures in their parts, which two figures multiplied together will be equal to the *diviſor.*

Tyro. I do not rightly apprehend you.

Philo. You remember, *Tyro*, in *queſtions* of *Multiplication*, that when any number was given in the table, you found two ſuch figures, which, when multiplied together, would make that number; ſo here alſo you do the ſame, only with this difference, that you here divide by them, inſtead of multiplying. Thus, ſuppoſe I was to divide by 24, by 32, by 48, or by 72, I firſt divide by 3, then by 8, for 3 times 8 is 24, and the laſt quotient is the anſwer. So if I divide by 48, I divide that number firſt by 8, and then the quotient I divide by 6, and have the proper anſwer, &c.

Ex.

EXAMPLE 1.

Divide 16488 *by* 24. Here 6 times 4 is 24.

Firſt by 6) 2748 *Quotient by* 6.

Then by 4) 687 *Quotient by* 24.

EXAMPLE 2.

Divide 126216 *by* 72. 6 times 12 is 72.

Firſt by 6) 21036 *Quotient by* 6.

Then by 12) 1753 *Quotient by* 72.

Tyro. I underſtand you; this is only then the reverſe of *Multiplication.*

Philo. Nothing more, as you may more plainly ſee by what follows.

2. *Of dividing* MONEY.

Diviſion of Money is juſt the reverſe of *Multiplication of Money*; for as in *Queſtions* of *Multiplication*, the money is increaſed ſo many times, according to the given number, ſo here the money is decreaſed, or divided into as many parts as the given number is.

It will be eaſier to your comprehenſion to take an example in *Multiplication*, and prove it by *Diviſion.*

If 1 ell coſt £. 1 - 3 - 8 what coſt 40 ells?
8
.8 9 - 9 - 4
5 5
40 £. 47 - 6 - 8 *Anſ.*

PROOF *by* DIVISION.

1. If 40 ells coſt £. 47 - 6 - 8, what coſt 1 ell?

Here I divide back by the ſame figures I multiplied by, carrying the pounds to the ſhillings, and the remainder of the ſhillings to the pence, doing by *twenties* and by *twelves*, as in *Addition.*

by 5) £. 47 - 6 - 8

Then by 8) 9 - 9 - 4 Price of 8.

£. 1 - 3 - 8 Price of 1. *Anſ.*

Here I divide, firſt, by 5, ſaying, the 5's in 47 is 9 times 5, and 2 over, which is £. 2; this £. 2 I carry to the 6*s.* and it is £. 2 - 6, or 46*s.* then I ſay, the 5's in 46 is 9 times 5 is 45, and 1 over, that is 1 ſhilling, which I carry to the 8 pence, and it is 1*s.* 8*d.* or 20 pence; then I ſay, the 5's in 20 is 4 pence. Now I divide this £. 9 - 9 - 4 by 8, ſaying, the 8's in 9 is *once*, and £. 1 over, which I carry to the 9 ſhillings, and it is £. 1 - 9, or 29 ſhillings; then I ſay, the 8's in 29 is 3 times 8 is 24, and 5 ſhillings over, which I carry to the pence, and it is 5*s.* 4*d.* or 64 pence; then I ſay, the 8's in 64 is 8 times. So is the price of one ell £. 1 - 3 - 8; as appears alſo by the work of *Multiplication.*

EXAMPLE 2.

Suppoſe £. 88 - 4 - 0 be divided among 56 poor widows, how much is the ſhare of each?

by 7) £. 88 - 4 - 0 Here 7 times 8 is 56.

by 8) 12 - 12 - 0 Share of 8.

Anſ. 1 - 11 - 6 Share of each.

If you underſtand the nature of multiplying any ſum by any figure, you ſee you may as readily divide it back again.

Tyro. Sir, I ſee the way of working it very plainly. Have you any thing farther to add?

Philo. Nothing more, as you ſay you are perfect; only ſome queſtions to exerciſe you.

3. QUESTIONS *to exerciſe* DIVISION.

1. Divide 822306485 by 1715. *Anſ.* 479479.
2. Divide 150348045 by 285. *Anſ.* 527537.
3. Divide 47198714 by 6357. *Anſ.* 7424, and 4346 remains.

QUESTIONS *in* MONEY.

1. Divide 1*l.* 16*s.* 8*d.* into 5 parts. *Anſ.* 7*s.* 4*d.*
2. Divide 4*l.* 8*s.* 1*d.* ½ into 9 parts. *Anſ.* 9*s.* 9*d.* ½.
3. Divide 25*l.* 5*s.* 4*d.* into 32 parts. *Anſ.* 15*s.* 9*d.* ½.
4. A gentleman left by will 100 pounds among threeſcore (or 60) poor perſons, to be paid every *Chriſtmas-Day*, how much is each to receive?

I leave this laſt queſtion wholly for the learner to do. And now, *Tyro*, you are come to that rule, in which you will exerciſe all the other *four*; therefore if you are not perfect, you will be at a loſs very often.

DIALOGUE VI.

SECTION I.

Of REDUCTION.

Tyro. WHAT is *Reduction*, and what does it teach?

Philo. *Reduction* is a rule compounded o all the foregoing rules, being a proper exerciſe for the better perfecting you in them. It teaches to *reduce* things of one denomination into another, and is of excellent uſe in common affairs of life.

Tyro. How many parts is this rule divided into?

Philo. Two. 1. *Reduction aſcending.* 2. *Reduction deſcending.*

Tyro. What do you mean by *Reduction aſcending?*

Philo. *Reduction aſcending* is when things of a *ſmall* are *reduced*, or *brought* into things of a *greater* denomination; as farthings into pence, pence into ſhillings, ſhillings into pounds, or ounces into hundred weights: and *this* remember is done by *Diviſion* only, by dividing by as many of the *leſs*, as make one of the *greater* denomination.

Tyro. What do you mean by *Reduction deſcending?*

Philo. *Deſcending* is juſt the reverſe of the other; for by *Reduction deſcending*, things of a *great* are *reduced* or *brought* into things of a *leſs* denomination; as pounds into ſhillings, ſhillings into pence, or farthings; *Cwts.* into pounds, tons into quarters, miles into yards, yards into inches, and the like; and *this* remember is always done by *Multiplication* only, by multiplying the *greater* denomination by as many as it contains of the *leſs* denomination.

Tyro. Then I find *Reduction deſcending* is the eaſier of the two, as it is performed by *Multiplication* only.

Philo. It is ſo; and that is the reaſon it is commonly taught firſt.

Note, I ſhall prove every ſum of *Reduction deſcending* by *Reduction aſcending*, and then you will ſee the nature of both.

1. *Of* REDUCTION *deſcending*.

Tyro. How do you ſay this is performed?

Philo. By this rule, *Multiply every denomination by as many as the next leſs denomination contains, and you have the anſwer, which is called* Reduction deſcending. Then to prove the work, *divide back by the ſame figures you multiplied by, and this is called* aſcending.

A few queſtions will make it plain to you.

Queſt. 1. In 12 pounds, how many ſhillings?

£. 12
Multiply by 20 ſhillings in a £.

Anſ. 240 ſhillings

PROOF *aſcending.*

In 240 ſhillings, how many *£. ſterling?*
Here I divide back by 20, as before I multiplied.
2|0)24|0 ſhillings

£. 12 *Anſ.*

Here I cut off the cyphers in the *diviſor* and *dividend* with a daſh of my pen, and divide by 2 only, and the anſwer is 12.

Queſt. 2. In £. 23 - 14*s.* how many ſhillings and pence?

£. 23 - 14
Firſt by 20   and take in the 14.

474
Then by 12

5688 pence.

P R O O F.

In 5688 pence, how many ſhillings and £. *ſterling*?
Divide by 12)5688 pence

Then by 2|0)47|4 ſhillings

£. 23 - 14 as above.

Here I divide by 12, and it brings the pence into ſhillings; then I divide by 20, cutting off the cypher, and cutting off the 4 alſo; then I divide by 2 only, ſaying, the 2's in 4 is *twice*, the 2's in 7 is 3 times 2 and 1 over, which 1 I place before the figure 4, that I alſo cut off, and it is 14 ſhillings.

This is a *general rule*; obſerve, that when you cut off any figure or figures, what remains in dividing muſt be placed before them, and is the true remainder.

Tyro. This is very plain, I own.

Philo. Then we will proceed to *queſtion* 3.

Queſt. 3. In £. 45 - 17 - $6\frac{3}{4}$, how many ſhillings, pence, and farthings?

£. 45 - 17 - $6\frac{3}{4}$
by 20

917 ſhillings
by 12

11010 pence
by 4

Anſ. 44043 farthings.

Here I multiply £. 45 by 20, and take in the 17 ſhillings, ſaying, 0 is 0, but 7 is 7; then twice 5 is 10 and the 1 by the ſide of the 7 ſhillings is 11, that is 1, and I carry 1; then twice 4 is 8, and 1 is 9, which is 917 ſhillings. Again, I multiply the ſhillings by 12, and take in the odd ſix-pence; and *laſtly*, I multiply the pence by 4, and take in the odd 3 farthings; ſo is the work done.

PROOF *by* REDUCTION aſcending.

In 44043 farthings, how many pence, ſhillings, and pounds *ſterling*?

Here I divide only back by the ſame figures I multiplied by, and it is done.

Divide by 4)44043 farthings

by 12)11010 pence, and 3 farthings over

by 2|0) 91|7 ſhillings and 6 pence over

£. 45 - 17 - 6¾ as above

Tyro. I underſtand it very well indeed.

Philo. Then I need not inſtruct you any more till ſome difficulty offers.

Queſt. 4. In £. 99 - 19 - 11¾, how many ſhillings, pence, and farthings?

£. 99 - 19 - 11¾

Multiply by 20

1999 ſhillings

by 12

23999 pence

by 4

95999 farthings

PROOF.

In 95999 farthings, how many pence, ſhillings, and pounds?

Divide by 4)95999 farthings

by 12) 23999—3

by 2|0) 199|9—11

£. 99 - 19 - 11¾

5. In 30 guineas, how many ſhillings and pence?

30 guineas
21 ſhillings make 1 guinea

30
60

630 ſhillings
12

7560 pence.

PROOF.

In 7560 pence, how many ſhillings and guineas?

12)7560 pence

21) 630(30 guineas, *Anſ.*
63

00

And thus you ſee, *Tyro*, that any ſum, of any name or denomination, may be reduced to another.

Queſt. 6. In £. 472 - 15*s.* how many crowns, ſhillings, groats, and pence?

£. 472 - 15
Multiply by 4 the crowns in a £. and count the 15*s.* for 3 crowns, ſaying, 4 times 2 is 8, and 3 is 11.
Crowns 1891
5 ſhillings 1 crown
Shillings 9455
3 groats 1 ſhilling
Groats 28365
4 pence is 1 groat
Pence 113460 *Anſ.*

P R O O F.

In 113460 pence, how many groats, ſhillings, crowns, and pounds?

Divide by 4) 113460 pence
by 3) 28365 groats
by 5) 9455 ſhillings
by 4) 1891
£. 472-3 crowns over, *viz.* 15 ſhillings, as above.

Note 1. To bring pounds into pence at one operation, *multiply by* 240, becauſe 240 pence make one pound.

To bring pounds into farthings at one operation, *multiply by* 960, the farthings in a pound. On the contrary,

Note 2. To bring pence into pounds, *divide by* 240.

To bring farthings into pounds, *divide by* 960.

AVOIRDUPOISE WEIGHT.

Queſt. 7. In 17*C.* 3 *qrs.* 15*lb.* how many *Cwt. qrs.* and *lbs.*

C. *qr.* *lb.*
17 - 3 - 15
by 4 *qrs.* make 1 *Cwt.*
———
71 *qrs.*
by 28 *lb.* 1 *qr.*
———
573
143
———
2003 *lbs. Anſ.*

Here I multiply by 4, and take in the odd 3 quarters; then I multiply by 28, and take in the odd 15 pounds, and the work is done.

P R O O F.

In 2003 pounds, avoirdupoiſe weight, how many quarters of hundreds, and hundred weight?

28)2003(71 *qrs.*
196
———
43
28
———
15 *lb.* over.

qrs. *lbs.*
4)71 - 15
———
17 - 3 - 15 as before
C. *qrs.* *lbs.*

Queſt. 8. In 17 *C.* 3 *qrs.* 15*lb.* how many *qrs. lbs.* and *oz.*

C. *qrs.* *lb.*
17 - 3 - 15
by 4
———
71 *qrs.*
28
———
573
143
———
2003 *lb.**
16
———
12018
2003
———
32048 *oz.* *Anſ.*

Note, The following method is very uſeful in many caſes to reduce hundred weights into pounds, being both ſhort and expeditious, *viz.*

* Set down the hundreds 4 times under one another in the following manner, and adding the odd pounds beſides, gives the anſwer.

17 *Cwt.*
17
17
17
99 *lb.* in 3 *qrs.* 15 *lb.*
———
2003 *lb.**

PROOF.

PROOF.

In 32048 ounces, how many *lbs. qrs.* and *Cwts.*
Divide this back again by 16, 28, and 4, and you will have 17 *C.* 3 *qrs.* 15 *lb.*

TROY WEIGHT.

Queſt. 9. In 5 *lb.* 2 *oz.* 14 *dwts.* of ſilver, how many *oz. dwts.* and *grs.*

lb. oz. dwts.
5 - 2 - 14
12 *oz.* 1 *lb. Troy by* 12
62 *oz.*
20 *dwt.* 1 *oz. by* 20 and take in 14 *dwts.*
1254 *dwts.*
24 *grs.* 1 *dwt. by* 24
5016
2508
30096 grains *Anſ.*

PROOE.

Divide back by the ſame figures 24, 20, and 12, and have a regard to the remainder, you'll find it 5 *lb.* 2 *oz.* 14 *dwts.* Do you now underſtand what has been ſhewn you?

Tyro. I do very well; and I can ſee that *reduction aſcending* is only the proof to the other, and that they prove one another in every reſpect.

Philo. If you are perfect in what I have ſhewn you, there is no occaſion to run through all the weights and meaſures, for they are done after the ſame manner

Tyro. I know it, Sir; but every example is a freſh encouragement.

Philo. True; and I am ready to give them.

DRY MEASURE.

Queſt. 10. In 14 loads, 15 buſhels, how many buſhels and pecks?

L. *B.*
14 - 15
40 buſhels 1 load, *mult. by* 40, and take in the 15 buſh.

575
4 pecks 1 buſhel

2300 pecks

PROOF.

In 2300 pecks, how many buſhels and loads?
Divide 2300 by 4, and that quotient by 40, and 15 will remain; which is 14 loads, 15 buſhels.

LIQUID MEASURE.

Queſt. 11. In 12 hogſheads of wine, how many gallons and pints?

12 hogſheads
by 63 gallons in 1 hogſhead of wine

36
72

756 gallons
by 8 pints 1 gallon

6048 *Anſ.*

PROOF.

In 6048 pints, how many gallons and hogſheads?
Divide this back again by 8, and by 63, and you will have juſt 12 hogſheads.

BEER

BEER MEASURE.

Queſt. 12. In 18 butts of beer, how many hogſheads and gallons?

18 butts
by 2 hogſheads 1 butt

36 hogſheads
by 54 gallons 1 hogſhead of beer

144
180

1944 gallons *Anſ.*

PROOF.

In 1944 gallons of beer, how many hogſheads and butts? *Anſ.* 18 butts.

CLOTH MEASURE.

Queſt. 13. In 26 yards, 3 quarters, how many quarters and nails?

Yards qrs.
26 - 3
by 4 quarters 1 yard, and take in the 3 *qrs.*

107 *qrs.*
by 4 nails 1 *qr.*

428 nails.

PROOF.

In 428 nails, how many quarters and yards?

Divide 428 by 4, and then by 4 again. *Anſ.* 26 yards 3 qrs.

Note. This and the two following queſtions are of great ſervice in the *Rule of Three Direct*; where it is often required to reduce yards and ells into quarters, and the contrary.

Queſt. 14. In 26 ells *Engliſh*, 3 quarters, how many quarters and nails?

Ells *qrs.*
26 - 3
by 5, and take in 3 qrs. 5 qrs. 1 ell *Engliſh*

133 qrs.
by 4 nails 1 qr.

532 nails

PROOF.

In 532 nails, how many qrs. and ells *Engliſh?*
Divide 532 by 4, and by 5, you'll have 26 ells *Engliſh*, 3 *qrs.*

Queſt. 15. In 26 ells *Flemiſh*, 2 qrs. how many quarters and nails;

Ells Fl. qrs.
26 - 2
by 3 qrs. 1 ell *Flemiſh*, take in 2 qrs.

80 qrs.
by 4 nails 1 qr.

320 nails. *Anſ.*

PROOF.

In 320 nails, how many quarters and ells *Flemiſh?*
Divide 320 by 4, and by 3, you'll have 26 ells *Flemiſh*, 2 *qrs.*

LONG MEASURE.

Queſt. 16. In 927 miles, how many yards, feet, and inches?

927 miles
In 1 mile are 1760 yards

55620
6489
927

1631520 yards
3 feet 1 yard

4894560 feet
12

58734720 inches

PROOF.

In 58734720 inches, how many feet, yards, and miles?

Divide back by the ſame figures, you'll have at laſt 927 miles.

Note, I ſhall give you a fuller example in this rule, when we come to *Compound Reduction*, there being *Diviſion* required when you are to bring rods into yards.

LAND MEASURE.

Queſt. 17. In 54 acres, how many roods and poles?

54 acres
4 roods 1 acre, *by* 4 or multiply 54 by 160, the rods in an acre, gives 8640 rods.

216
40 rods 1 rood, *by* 40

rods 8640

PROOF.

In 8640 rods or poles, how many acres?

Divide by 40, and then by 4, or divide 8640 by 160, and it gives 54 acres.

SQUARE MEASURE.

Queſt. 18. In 217 ſquare yards, 3 feet, how many ſquare feet, inches, and ſquare quarters?

	Square yards Feet.	
	217 - 5	
9 ſquare feet 1 yard, *by*	9	
	1958	ſquare feet
144 inches 1 foot	144	
	7832	
	7832	
	1958	
	281952	ſquare inches
16 ſquare qrs. 1 inch	16	
	1691712	
	281952	
	4511232	ſquare quarters

PROOF.

In 4511232 ſquare quarters, how many ſquare inches, feet, and ſquare yards?

Divide this number back by 16, you have ſquare inches; then by 144, you have ſquare feet; and *laſtly*, by 9, you'll have 217 yards, 5 feet.

Note, That 12 times 144, or 1728 ſolid inches, make a *ſolid foot*; ſo that you are to multiply *ſolid feet* by 1728, to bring them into *ſolid inches*; and on the contrary, to bring *ſolid inches* into *ſolid feet*, you muſt *divide* by 1728.

TIME,

TIME.

Queſt. 19. How many days, hours, minutes, and ſeconds are expired ſince the birth of our Lord and Saviour *Jeſus Chriſt*, ſupppoſing it 1767 years, 217 days, 17 hours, and 35 minutes, and allowing juſt 365 days to a year.

Years Days Hours Min.
1767 - 217 - 17 - 35
365

8842
10603
5303

645172 days
24

2580695
1290345

15484145 hours
60

929048735 minutes
60

55742924100 ſeconds

PROOF.

In 55742924100 ſeconds, how many minutes, hours, days, and years?

Divide this by 60, 60, 24, and 365, and you will find 1767 years, 217 days, 17 hours, 35 minutes.

Note, According to your tables in time, 365 days, 6 hours, make a year; therefore, as many years as are given, you muſt multiply them by 6, and add them to the hours.

Queſt. 20. If a lad be juſt 12 years old, how many hours are ſince expired?

12 years	12 years
*365	6 odd hours in 1 year
4380 days	72 odd hours in 12 years
24	
17520	
8760	
105120 hours	
and 72 odd hours	
105192	

* *Note*, Though I ſet 365 under 12, yet I multiply 365 by 12, becauſe it is done in one line.

SECTION II.

Of COMPOUND REDUCTION.

Tyro. WHY do you call this *Compound Reduction?*

Philo. Becauſe it is compounded of *Multiplication* and *Diviſion*, and cannot be done without both.

Tyro. What is its particular uſe?

Philo. It teaches us to reduce any ſort of foreign money into pounds *ſterling*, and the contrary; ſo that it is uſeful in all buſineſs and traffic, as appears by the following table and examples.

A ſelect

A ſelect ALPHABETICAL TABLE *of foreign Coins.*

NAMES.	*Value Sterling.*	*What Country.*
Abaſhee	16 pence	*Perſia*
Aſar	6*s*. 8*d*.	*Ditto*
Aſper	3 farthings	*Turky*
Beſſe	3 halfpence	*Perſia*
Capan	3 pence	*Eaſt-India*
Capeck	1 penny	*Muſcovy*
Cohan	30 ſhillings	*Japan*
Chriſtiana	16 pence	*Sweden*
Copſtake	1 ſhilling	*Germany*
Cruſado	6*s*. 2*d*.	*Ditto*
Ditto	2*s*. 10*d*.	*Portugal*
A Crown	4*s*. 6*d*.	*France*
Ditto	5*s*. 3*d*.	*Florence*
Ditto	7*s*. 6*d*.	*Rome*
Ditto	1*l*. 2*s*.	*Barcelona*
A Dina	1*l*. 10*s*.	*Aleppo*
A Dollar	4*s*. 6*d*.	*Italy*
A Lion Dollar	4 ſhillings	*Aleppo*
A Croſs Dollar	4*s*. 2*d*.	*Holland*
A *Specie* Dollar	5 ſhillings	*Ditto*
A *Zealand* Dollar	3 ſhillings	*Ditto*
Old Philip's Dollar	5 ſhillings	*Holland*
Leopold's Dollar	4*s*. 3*d*.	*Ditto*
Rudolphus's Dollar	4*s*. 4*d*.	*Ditto*
Prince of *Orange*'s Dollar	4*s*. 4*d*.	*Ditto*
Maximilian's Dollar	4*s*. 5*d*.	*Ditto*
Ferdinando's Dollar	4*s*. 3*d*.	*Ditto*
Dollar	2*s*. 3*d*.	*Dantzick*
Dollar	2*s*. 3*d*.	*Sweden*
A Rix-Dollar of the empire	4*s*. 3*d*. ¾	*Germany*
A Ducat	4*s*. 8*d*.	*Hungary*
Ditto	4*s*. 8*d*.	*Poland*
A *Valentian* Ducat	5*s*. 3*d*.	*Spain*
A *Saragoſa* Ducat	5*s*. 6*d*.	*Ditto*
A *Barcelona* Ducat	6 ſhillings	*Ditto*
Ducat	5 ſhillings	*Naples*
A Ducatoon	6*s*. 3*d*.	*Holland*
A piece of *Eight* in common	4*s*. 6*d*.	*Spain*

NAMES.	*Sterling.*	*Country.*
A *Mexico* piece of Eight	4*s.* 6*d.* and 4*s.* 4*d.* ½	*Spain*
A *Peru* piece	4*s.* 5*d.*	*Ditto*
A Florin	4*s.* 4*d.*	*Ditto*
Ditto	3*s.* 4*d.*	*Germany*
Ditto	2*s.* 6*d.*	*Sicily*
Ditto	2 ſhillings	*Holland*
Greven	1 ſhilling	*Muſcovy*
Guilder, or Gilder	3*s.* 8*d.*	*Germany*
Ditto gold	4*s.* 9*d.*	*Ditto*
Ditto of *Noremberg*	7*s.* 1*d.*	*Ditto*
Ditto	5 ſhillings	*Portugal*
Ditto	18 pence	*Dantzick*
A Harpur	9 pence	*Iriſh*
A Livre is 20 Sous	18 pence	*France*
A Mark	13*s.* 4*d.* not current	*England*
Ditto	16 ſhillings	*Denmark*
Ditto	2 ſhillings	*Germany*
Mark-Lups	3*s.* 9*d.* ¾	*Poland*
Meſſe	15 pence	*Eaſt-India*
Mill-Ree (is 1000 Rees)	6*s.* 9*d.* nearly	*Portugal*
A Moidore, marked 4000, or 4 times 6*s.* 9*d.* *viz.*	27 ſhillings	*Ditto*
An Obb, or Cobb, ½ a Harpur	4*d.* ½ penny	*Iriſh*
A Pattacoon, or Pettavoon	4*s.* 8*d.*	*Spain*
A Ruble	10 ſhillings	*Muſcovy*
Seraph	5 ſhillings	*Turky*
Timph	7 pence	*Poland*
Tical	2*l.* 16*s.* 3*d.*	*China*
Tari	5 pence	*Sicily*
Tomangold	3*l.* 6*s.* 8*d.*	*Perſia*
Zachin	7*s.* 6*d.*	*Venice*
Zelot	7*d.* ½ penny	*Turky*

The cuſtomary gold coins of *England* are,

	Dwts.	*Grs.*
A Guinea, which when firſt coined weighs	5 -	9
A Half-guinea	2 -	16½
A Quarter-guinea	1 -	8¼

By act of Parliament, and his Majeſty's Proclamation, iſſued in *April* 1776, all gold coin muſt be of the weight ſpecified in the following table, or it is not allowed to be current, *viz.*

	Dwts.	*Grs.*
Guineas	5 -	8
Half-guineas	2 -	16
Quarter-guineas	1 -	8

Tyro. I am obliged to you, ſir.

Philo. And now, *Tyro*, I will give a variety ſufficient for any careful learner to do any queſtion relating to the common courſe of buſineſs; but before you begin, I would deſire you to mind the two following obſervations.

Obſervation 1. When one ſum of money, or any weight or meaſure, is to be brought into another ſum of a different name or denomination, then always remember, that before you divide, you make the *diviſor* and *dividend* of the ſame name. That is, if the *dividend* be pounds, pence, yards, ſhillings, &c. your *diviſor* muſt alſo be of the ſame name.

Obſervation 2. Take notice likewiſe, that your *remainder* is always of the ſame name as your *dividend* and *diviſor*, be it what it will. Theſe obſervations kept in memory, will be of great ſervice to you in the *Rule of Three direct*, and in all common rules of arithmetic.

1. QUESTIONS *in* COMPOUND REDUCTION.

In 324 moidores, how many pounds?

324 moidores
1 moidore 27 ſhillings
2268
648
Shillings 2|0)874|8
£. 437 - 8*s.*

2. A merchant at London delivers to his correſpondent as much broad-cloth as comes to £. 547 - 14 - 7; and he is to receive the ſame in croſs dollars, at 4*s.* 2*d.* each. How many muſt he receive?

Rule. Bring the money into pence, and divide by the pence in 1 dollar.

s. *d.*
4 - 2
12
50

£. 547 - 14 - 7
20
10954 ſhillings
12
Pence in a dollar 5|0)13145|5

Anſ. 2629 croſs dollars, and 5*d.*

3. How many cruſadoes, at 6*s*. 2*d*. each, muſt be paid for 1000 guilders of *Noremberg*, at 7*s*. 1*d*. each?

s. *d*. 1000 guilders
Cruſado 6 - 2 85 *s*. *d*.
12 ——— 7 - 1 guilder
— 74)85000(1148 12
74 pence 74 —
——— 85
110
74
———
360
296
———
640
592
———
48 pence

Anſ. 1148 cruſadoes and 4 ſhillings=48*d*.

Queſt. 4. How many rix-dollars, at 4*s*. 3*d*. ¼ each, may I receive for £. 1750 - 15 - 6½ ſterling?

Rule. Bring the ſterling money into farthings, and divide by the farthings in 1 dollar.

```
   s.  d.                    £. 1750 - 15 - 6½
   4 - 3¼                         20
  12                         ---------
 ----                          35015 ſhillings
  51                              12
   4                         ---------
 ----                         420186 pence
 205                               4
                             ---------
Farthings in 1 dollar  205)1680746(8198 rix-doll. Anſ.
                           1640          and 156 farth. of
                           --------      3s. 3d.
                             407
                             205
                           --------
                            2024
                            1845
                           --------
                             1796
                             1640
                           --------
                       by 4)156 farthings over*
                           --------
                      by 12)39 pence
                           --------
                              3 - 3 pence
```

Tyro. * The *remainder* I ſee is farthings, as well as the *dividend*; and I ſuppoſe you divide it by 4, and by 12, to bring it into pence and ſhillings: Do you not?

Philo. You ſay right; and all other queſtions are done after the ſame manner.

Queſt. 5. In 276 cruſadoes, at 6*s.* 2*d.* each, how many *Hungarian* ducats, at 4*s.* 8*d.* each?

s. d. 276 cruſadoes
4 - 8 74 pence in a cruſado
12 s. d.
1104 6 2
56 1932 12

Pence in a ducat 56)20424(364 ducats, *Anſ.* 74
168

362
336

Anſ. 364 ducats, and 40 pence over, or 3*s.* 4*d.*

264
224

40 pence over

Queſt. 6. In £.347 - 15 - 7, how many *French* crowns, at 4*s.* 6*d.* $\frac{1}{8}$ each?

£.347 - 15 - 7
20

6955 ſhillings
12

d.
A crown 54$\frac{1}{8}$
8

433 eighths

83467 pence
8 eighths in 1 penny

433)667736(1542 *Anſ.* 1542 *French* crowns and 6*d.* $\frac{2}{8}$ $\frac{1}{4}$.
433

2347
2165

1823
1732

916
866

8)50

6$\frac{2}{8}$ $\frac{1}{4}$

Here I multiply the pence by 8, and the *dividend* and the *diviſor* an eighth of a penny, the *remainder* alſo is eighths of a penny; therefore, I divide it by 8, and it is 6 pence and 2-8ths over.

Note 1. As you do not underſtand fractions as yet, it may not be amiſs to give you a word or two by way of information. You ſee a *French* crown in the above example is valued at 54*d.* 1-eighth, that is, 54 pence and 1-eighth of a penny, which 1-eighth is called a fraction; the 1 which ſtands at top is called the numerator, and the 8 is the denominator: ſo alſo $\frac{3}{7}$ is read 3-ſevenths, $\frac{5}{11}$ is 5-elevenths, and $\frac{3}{5}$ is 3-fifths. Here 3, 5, and 3, are numerators, and 7, 11, and 5, are the denominators.

Note 2. The Rule to work by fractions in all ſuch caſes as this, is thus: Multiply the whole number by the *denominator*, that is, the lower figure of the fraction, and take in the top figure, or *numerator*.

Queſt. 7. A merchant ſends to his correſpondent as much corn as comes to £. 1575, to receive the ſame in ducatoons, at 6*s.* 3*d.* $\frac{3}{5}$ each; how many ought he to receive?

s. *d.*
6 - 3$\frac{3}{5}$
12
———
75
by 5, and take in the top 3
———
378 fifths

£. 1575
20
———
31500 ſhillings
12
———
378000 pence
by 5 brings *d.* into 5ths
———
diviſor 378)1890000(5000 ducatoons
1890 *Anſ.*
———
000

Queſt. 8. In £. 1000 how many 7 pence half-pennies?

£. 1000
20
20000 ſhillings
12
240000 pence
4
Farthings in $7\frac{1}{2}$ are 3|0)96000|0
32000 *Anſ.*

Or thus:
900 farth.
1000
3|0)96000|0
32000 *Anſ.*

Queſt. 9. In 100 *Portugal Pieces*, at 36 ſhillings each, how many pounds, half crowns, and crowns?

Piece 36 ſhillings
100
2|0)360|0 ſhillings
180 pounds
8 half crowns 1 pound
2)1440 half crowns
720 crowns

Here you ſee I multiply, or divide always by as many of the *leſs* as make one of the *greater*, according as the nature of the queſtion requires.

Queſt. 10. In 432 moidores, how many ſhillings, crowns, groats, and farthings?

	432	moidores
	27	ſhillings 1 moidore
	3024	
	864	
Shillings in 1 crown	5)11664	ſhillings
Crowns	2332	4s. over, or 12 groats
Groats in 1 crown	15	and take in 12 groats
	11662	
	2333	
	34992	groats
Farthings in 1 groat	16	
	209952	
	34992	
	559872	farthings

Tyro. I ſee now, Sir, the nature of the rule plainly; but pray how do you manage when there is a ſum of money to be paid in pieces of different value, and that there ſhall be as many in number of one ſort as of another, that is, an equal number of every ſort?

Philo. This is very uſeful in many reſpects, and is done by this general rule, *viz.* Add all the pieces together, then bring the ſum of money to be paid, and the ſum of all the pieces, into one name or denomination; and *laſtly*, divide the ſum to be paid by the total of all the pieces, and the quotient is the number of each, one with another.

Queſt. 11. How many ſhillings, ſix-pences, four-pences, three-pences, two-pences, pence, half-pence, and farthings, of each a like number, will diſcharge a debt of £.335 - 8 - 4? *Anſ.* 2800 of each.

I ſet down all the pieces one under another, as follows:

```
A ſhilling is 12
               6
               4
               3        £.335 - 8 - 4
               2             20
               1        ----------
               ½           6708 ſhillings
               ¼             12
            -----       ----------
Pence        28¼          80500 pence
              4               4
            -----       ----------
Farthings   115      115)322000(2800 pieces of each ſort
                         230
                         ------
                          920
                          920
                         ------
                           00
```

Here I bring £.335 - 8 - 4 into farthings, and divide by 115, the farthings in all the pieces, and the anſwer is 2800 of each.

OBSERVATION 1.

1. When any pieces of money are to be brought into pounds *ſterling*, you ſhould conſider what relation thoſe pieces bear to a pound *ſterling*; that is, what part of a pound they conſiſt of; for by this the work will be rendered much ſhorter, and you will not have occaſion to reduce the work into pence; but of this I ſhall ſhew you more fully in the *Rule of Three Direct.*

Queſt. 12. In £.270 how many nobles, at 6*s.* 8*d.* each?

```
270
  3 nobles, or 3 time 6s. 8d. is 1 pound
———
810 Anſ.
```

To bring nobles into pounds, divide by 3.

Queſt. 13. In £.270 how many marks at 13*s.* 4*d.*

Here, as 13*s.* 4*d.* is two-thirds of a pound, I multiply the pounds by 3, and divide by 2, as follows:

```
   270
     3
  ————
 2)810
  ————
   405 marks.  Anſ.
```

Tyro. This is much ſhorter than to bring the *pounds* and the *marks* into pence, and have to divide beſides.

Philo. To be ſure it is; and when you want to bring *marks* into *pounds*, then multiply by 2, and divide by 3; for you muſt have leſs *pounds* than *marks*, becauſe a *pound* is larger than a *mark*. And thus, *Tyro*, by your care and obſervation you may work many ſums ſhorter than by the common form of rules in general laid down; for it is impoſſible (without a large volume indeed, and even not then) to lay down rules and examples to make a careleſs learner underſtand: but a diligent learner, that is deſirous to know and make himſelf perfect, will not only obſerve the rules given him, but will alſo try and contrive methods of his own, and is not ſatisfied with knowing things by halves.

Queſt. 14. Suppoſe a bill of exchange was accepted at *London*, for £.580, for value received at *Amſterdam*, how many *Flemiſh* pounds ought to be remitted at *Amſterdam*?

s. *d.*
33 - 4 one *F.* pound
12

Diviſor 400 pence

£.580
20

11600
12

4|00)1392|00

Anſ. 348 *Flemiſh* pounds

Do you underſtand it?

Tyro. I do; for let the queſtion be what it will, I have nothing to do but make them both of a name, and multiply or divide by as many of the leſs as make one of the greater; then the quotient (if a diviſion ſum) will be the anſwer, and the remainder the ſame as the dividend.

Philo. Very well; then I will ſet you one ſum more for trial.

Queſt. 15. A General of an army, (conſiſting of 5000 men) after a very ſharp engagement, loſt 2380 men; but coming off victorious, he, for their valiant behaviour, gave 1000 guineas to be equally divided among them, and the remainder (if any) to be given to a little errand-boy. How much did each man receive?

Tyro. I proceed thus: I take 2380 men, that were loſt, out of 5000, and there remains 2620 that eſcaped. Then I reduce 1000 guineas into farthings, and find it 1008000, and dividing this by the number of men that eſcaped, *viz.* 2620, I find the quotient 384 farthings, that is, juſt eight ſhillings each man, and 192 farthings remaining over, which is four ſhillings for the little errand-boy, as appears by the following work.

5000 ſoldiers
2380 killed

Diviſor 2620 eſcaped
1000 guineas
21

21000 ſhillings
12

252000 pence
4

Men
262|0)100800|0 (384 farthings each
786

2220
2096

1240
1048

4)192 farthings remain

12)48 pence

4 ſhillings for the little boy.

4)384 farthings

12) 96 pence

8 ſhillings each. *Anſ.*

Philo. Very well done indeed.

LONG

LONG MEASURE.

Queſt. 16. How many furlongs, rods, yards, feet, inches, and barley-corns, will reach round the world, ſuppoſing it (according to the beſt calculation) to be 25020 miles in circumference?

25020 miles *
8

200160 furlongs
40

8006400
11 half yards in 1 rod †

by 2)88070400 half yards

44035200 yards
3

132105600 feet
12

1585267200 inches
3

4755801600 barley-corns

* According to this calculation of 25020 miles round the globe, 69½ miles make 1 degree. See the *note* in *page* 44, *Long Meaſure*.

† *Note*, That 5½ yards make 1 rod; but becauſe I cannot well multiply by 5½, I therefore multiply by 11, and they are ½ yards, and then divide by 2, to bring them into yards.

Another way.

As 1760 yards make a mile, if you multiply 25020 by 1760, you will have the ſame anſwer in yards; and if you multiply the yards by 36, you will have the inches, &c.

SECTION III.

QUESTIONS *to exerciſe* REDUCTION.

1. IN £.56, how many crowns and ſix-pences? *Anſ.* 224 crowns, and 2240 ſix-pences.

2. In 8568 pence, how many ſhillings and guineas? *Anſ.* 714 ſhillings, and 34 guineas.

3. In £.12 - 2 ſhillings, how many groats, three-pences, and ſix-pences? *Anſ.* 726 groats, 968 three-pences, and 484 ſix-pences.

4. In 750 pounds, how many moidores and guineas? *Anſ.* 555 moidores, and 15 ſhillings, and 714 guineas, and 6 ſhillings over.

5. In 500 *Ports*, at 36*s.* each, how many pounds, half crowns, crowns, and groats? *Anſ.* £.900, 7200 half crowns, 3600 crowns, and 54,000 groats.

6. In £.500, how many pieces, at 7*d.* $\frac{1}{2}$, and pieces at 7*s.* 6*d.* each? *Anſ.* 16,000 pieces, at 7*d.* $\frac{1}{2}$; and 1333 pieces, at 7*s.* 6*d.* each, and $\frac{1}{3}$ of a piece, or 2*s.* 6*d.*

7. A merchant at *Holland* draws a bill upon his correſpondent in *London*, for 2500 ducatoons, at 6*s.* 2*d.* $\frac{3}{5}$ each, how many pounds *ſterling* ought he to receive at *London*? *Anſ.* £.777 - 1 - 8.

Rule. Bring a *ducatoon* into 5ths of a penny, (as in *page* 138) and multiply the number of *ducatoons* by them; then bring a pound *ſterling* alſo into fifths, (*viz.* 1200 fifths) and dividing by 1200, you will have £.777 $\frac{1}{12}$; that is, £.777 one-twelfth of a pound, or 1*s.* 8d.

8. A rich nobleman has 5 villages, in every village 3 ſtreets, in every ſtreet a dozen houſes, in every houſe 5 rooms, in every room 2 bureaus, in every bureau 12 drawers, in every drawer 4 bags, every bag valued at 150 guineas, which he is going to exchange for £.3 - 12 ſhilling pieces, how many muſt he receive in all?

Rule. Multiply all the numbers by one another as they follow in order, and your laſt product will be guineas. Bring theſe guineas into ſhillings, and divide by 72, the ſhillings in a £.3 - 12 piece, you'll have the anſwer, which is 3780000 pieces, at £.3 - 12 ſhillings each.

And thus, *Tyro*, you may by diligence and obſervation do any ſort of ſum.

Tyro. Sir, I ſee it plainly, and will try to do them all, and prove their anſwers, the firſt opportunity.

Philo. Then I will now proceed to the moſt beautiful and moſt uſeful rule in all common *arithmetic*, *viz.* the *Rule of Three Direct*, commonly called the *Golden Rule of Three.*

DIALOGUE VII.

SECTION I.

The ſingle RULE OF THREE DIRECT, *commonly called the* GOLDEN RULE.

Tyro. WHAT do you mean by the *Rule of Three Direct?*

Philo. The *Rule of Three* is the *Rule of Proportion*; becauſe it ſhews what *relation* or *proportion* one number bears to another.

Tyro. What is given, and what is required in the *Rule of Three.*

Philo. *Three* numbers are given to find a *fourth*, which is the anſwer.

Tyro. How is this *fourth* number found?

Philo. By this one *general rule*. Multiply the ſecond number by the third, and divide by the firſt.

Tyro. How does the proportion of theſe 4 numbers ſtand, or what relation do they bear to each other?

Philo. As the *firſt* is to the *ſecond* number, ſo is the *third* to the *fourth* number. For if you multiply the *fourth* number, or *anſwer*, by the *firſt*, the product will be the ſame as the *third*, multiplied by the *ſecond*, but more of this by and by.

Tyro. How am I to work the *Rule of Three Direct?*

Philo. By the following rule, which you ought ſo far to get by heart, as to underſtand it without book.

A General RULE.

1. When any 3 numbers are given, place them one after the other, in order as they ſtand, and this is called ſtating the queſtion.

This being done, multiply the *ſecond* by the *third*, and divide by the *firſt*, and you have the *fourth* number, or anſwer.

Let the three numbers be 4, 8, and 12.
As 4 : 8 :: 12 to a 4th number, *viz.* 24.
8 Thus 4 : 8 :: 12 : 24, thus
— read, as 4 *is to* 8, *ſo is* 12 *to* 24.
4)96
—
24 *Anſ.*

Here you ſee the *fourth* number, or anſwer, is 24.

Now, *Tyro*, it is worth your while to obſerve what *relation* or *proportion* theſe bear to each other.

OBSERVATION 1.

As the *firſt* is to the *ſecond*, ſo is the *third* to the *fourth*. That is, as 4 is to 8, ſo is 12 to 24: for 4 is the half of 8, and 12 is the half of 24.

OBSERVATION 2.

As the *firſt* is to the *third*, ſo is the *ſecond* to the *fourth*. That is, as 4 is to 12, ſo is 8 to 24: for 12, the *third* number, is 3 times more than 4, the *firſt* number; and 24, the *fourth* number, is 3 times more than 8, the *ſecond* number; or, in other words, thus: the *third* divided by the *firſt*, is equal to the *fourth* divided by the *ſecond*. And thus you will find the *proportion* holds good, take the numbers which way you will, as by the following *obſervations*.

OBSERVATION 3.

The *firſt* number is equal to the product of the *ſecond* and *third*, divided by the *fourth*; that is, 96 divided by 24 is equal to 4.

OBSERVATION 4.

The *ſecond* is equal to the product of the *firſt* and *fourth*, divided by the *third*; that is, 96 divided by 12 is equal to 8.

OBSERVATION 5.

The *third* is equal to the product of the *firſt* and *fourth*, divided by the ſecond; that is, 96 divided by 8 is equal to 12.

OBSERVATION 6.

The *fourth* is equal to the product of the *ſecond* and *third*, divided by the *firſt*; that is, 96 divided by 4 is equal to 24.*

Tyro. This is very pretty indeed! and will this *proportion* hold ſo in any other 3 numbers?

Philo. No doubt of that; if you will try any 3, you will find they will anſwer to the foregoing *obſervations*.

This is only to ſhew you, *Tyro*, the nature of proportion, relating to numbers, without any particular name; but as for working the *Rule of Three Direct*, when the numbers are called by the names of *pounds*, *yards*, *ells*, *ounces*, *pence*, or the like; that indeed is the effect of practice, and may very ſoon be learned by the following inſtructions, or directions.

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* See more of this in my *Young Algebraiſt's Companion*, dialogue 7, ſection 2.

SECTION II.

Containing ſome full and neceſſary Directions for the better performing this Rule.

Tyro. YOU have already told me, that there are always *three numbers* given to find a *fourth*; but in what order am I to place them, when they are of a different name or denomination. That is, *How am I to ſtate the queſtion?*

Philo. Do you but mind the following inſtructions, and read your queſtions over ſlow and conſiderately, and you will ſoon know how to *ſtate them*, or place the numbers in their order; for I ſhall firſt of all give you directions to work common eaſy ſums, and then ſhew you how to proceed when the *firſt* and *third* numbers are not alike, and when there is required two or three ſtatings.

SECTION III.

Directions to ſtate and work eaſy Queſtions in the RULE OF THREE DIRECT.

Firſt. ALWAYS remember that when three numbers are given, two of theſe numbers always are of one and the ſame name and denomination, *viz.* either money, weight, or meaſure, which *two numbers* out of the *three* muſt be your *firſt* and your *third* number, and the other in courſe muſt be placed in the middle, which *middle number* will always be of the ſame name as the anſwer. Thus, if the *ſecond* or *middle number* be *money*, *weight*, or *meaſure*, ſo alſo will the *fourth number* or *anſwer* be.

2. If at any time the *firſt number*, or the *third*, be of a higher or greater denomination than the other, then make them both of one denomination by the rules of *Reduction*. Thus, if the *firſt number* be yards, and the *third number* ells, reduce them both into quarters, by multiplying the yards by 4, and the ells by 5; ſo

alſo if the *firſt number* be *lbs.* and the *third Cwts.* and *qrs.* you muſt reduce the *Cwts.* and *qrs.* into *lbs.* that they may not only be of one name, (weight, meaſure, *&c.)* but likewiſe the very ſame name, *viz. pounds, pence, yards, quarters*, &c.

3. If your *ſecond number* be a compound quantity, ſuch as *pounds, ſhillings*, and *pence*, or *Cwts. qrs.* and *lbs.* you muſt reduce it into *pence*, or into *lbs.* by the rule of *Reduction*; and remember, that after you have multiplied the *ſecond* by the *third*, and divided by your *firſt*, the quotient will be of the ſame name as you reduced your *ſecond* number into, be it what it will.

4. In all queſtions in the *Rule of Three*, where there are only three numbers given, you have already been told, that *two* of thoſe *three* will always be of one name, and muſt be your *firſt* and *third* numbers. Now, it is very eaſy to know which of thoſe *two* muſt be your *third* number; for whenever a queſtion is aſked, or whatſoever number follows the queſtion, *that* is your *third* number. Thus, what coſt 24 yards? or how much does 96*lb.* coſt? Here 24, or 96, will be your *third* number; and ſo for any other queſtion, as you will ſee by the two firſt examples, as follows:

Queſt. 1. If 3 yards coſt 7 ſhillings, what coſt 24 yards?

Yds. ſhill. yds.
If 3——7——24
7 multiply
Divide by 3)168
by 2|0) 5|6 ſhillings
2*l.* 16*s.* *Anſ.*

Proof, or proportion.
As 3 : 7 :: 24 : 56. For 3 times 56 is 168, and 7 times 24 is 168. And thus for any other queſtion.

Queſt. 2. If 8 ells coſt 11 ſhillings, what coſt 96 ells?

Ells ſhill. ells.
If 8——11——96
11
8)1056
2|0)13|2
£. 6 - 12 *Anſ.*

☞ *Note*, Here you ſee that the queſtion is aſked, What coſt 24 yards, or what coſt 96 ells? therefore you may be ſure theſe are to be your third numbers. Then your *firſt* is plainly known by being of the ſame name; and your *middle*, or *ſecond* number, muſt be known of courſe, which will always be the ſame name as the anſwer. See *obſervation* 1.

Rule. Having ſtated the queſtion, I multiply the *ſecond* by the *third* number, or the *third* by the *ſecond*, and divide by the *firſt*, and the anſwer is 56 ſhillings, which is the ſame name as the ſecond number; then I divide thoſe ſhillings by 20, and have the anſwer. The ſecond queſtion is done the ſame.

Tyro. I ſee the nature of it plainly; but there is a way to prove ſums in the *Rule of Three*, by ſtating them backwards, is there not?

Philo. Yes, and a very good method it is to confirm you in the truth of what you have done; for the queſtion will then be turned quite the reverſe way.

Firſt Proof, or Variation.

If 24 yards coſt 56 ſhillings, what coſt 3 yards?

Yards ſhill. yards
If 24—56——3
3
24)168(7 ſhillings. *Anſ.*
168
0

Here you ſee the *fourth* number in the original queſtion is the *firſt* number in this queſtion; the anſwer in the original is the *ſecond* number; and the *ſecond* number in the original is the anſwer here.

Second Proof, or Variation.

If 7 ſhillings buy 3 yards, how many can I have for 56 ſhillings?

Here I find two numbers out of the three are money, and the number following the queſtion *(how many)* is 56 ſhillings; therefore 56 ſhillings is my third number, which is thus ſtated.

```
    Shill.  yards  ſhill.
If  7 ——— 3 ——— 56
                 3
               ———
             7)168
               ———
                24 yards.  Anſ.
```

So that you ſee, by minding which *two* of the *three* are of the ſame name, it is no difficult matter to ſtate any common queſtion, and others more difficult will naturally follow by uſe and practice.

Tyro. I underſtand it very well indeed, and heartily thank you.

Philo. Then I ſhall proceed to give you more uſeful examples, and when any thing occurs that you don't rightly apprehend, aſk me, or read the inſtructions over again.

Queſt. 3. If 3 *lb.* of tobacco (or any other thing) coſt 2*s.* 9*d.* what coſt 255 *lb.*

lb. *s.* *d.* *lb.*
If 3 —— 2 - 9 —— 255
12 33 ſecond number
—— ——
33 765
765
——
3)8415
——
12)2805 pence
——
2|0) 23|3 - 9
——
11 - 13 - 9

P R O O F.

Pence *lb.* *pence*
If 2805 —— 255 —— 33
33
——
765
765
——
2805)8415(3 *lb.* *Anſ.*
8415
——
0

☞ The *ſecond number* being *ſhillings* and *penee*, I bring it into pence, by multiplying by 12, and taking in the odd 9 pence; and after I have multiplied the *third number* 255 by 33, and divided by my *firſt*, which is 3, the quotient is of the ſame name ſtill, *viz.* pence, which I divide by 12, to bring into ſhillings, and by 20 to bring them into pounds, as above; and thus for any common ſum. See *obſervation* 2.

Queſt. 4. If an ounce of tobacco coſt 5 farthings, what coſt 2 *C.* 3 *qrs.* 21 *lb.*

oz. *farth.* *C.* *qrs.* *lbs.*
If *.1 —5—2—3—21
4
11 *qrs.*
28
89
24
329 *lbs.*
16
1974
329
5264 *oz.*
5 *ſecond number*
4)26320 farthings
12)6580 pence
2|0) 54|8 - 4*d.*
£.27 - 8 - 4 *Anſ.*

* *Note*, Becauſe the *firſt* number is ounces, I bring the *third* number alſo into ounces, to anſwer it; but after I have multiplied by my *ſecond* number 5, they are all farthings; and as my *firſt* number is only an unit (or 1) I do not divide by *that*; for 1 neither multiplies nor divides: I therefore only divide the farthings by 4, 12, and 20, and the queſtion is done. See the *proof* of the next queſtion.

Queſt. 5. If 2 *C.* 3 *qrs.* 21 *lb.* (or 5264 ounces) coſt £. 27 - 8 - 4, what coſt an ounce?

oz. £. *s.* *d.* *oz.*
If 5264——27 - 8 - 4——1
20
548
12
6580
4
5264)26320(5 farth. *Anſ.*
26320
0

☞ Take notice that whenever your *firſt* number is large, and the *third* ſmall (as in this example) that you always reduce the *middle* or *ſecond* number to its loweſt denomination.

Queſt. 6. Bought a ſilver cup and tankard, which weighed 3 *lb.* 11 *oz. troy*, and coſt me £. 8 - 18 - 2½; what did they lie me in per ounce?

Here, as the queſtion is, *What did they coſt per ounce?* you muſt know your anſwer is to be in money; ſo alſo muſt your *ſecond* number be, and the other two numbers will naturally follow, thus:

lbs. *oz.* £. *s.* *d.* *oz.*
If 3 - 11————8 - 18 - 2½————1
12 *oz.* 1 *lb. troy* 20
47 *oz.* 178
12
2138 pence
4
47)8554(182 farthings. *Anſ.*
47
385
376
94
94
0

4)182 farthings
12)45 - 2
3*s.* 9*d.* ½ *per oz.* *Anſ.*

Queſt. 7. A gentleman has an eſtate which brings him in clear £.2000 a year, and the charges he is at, one day with another, for houſekeeping, and other expences, are £.5 - 15*s.* I demand what he loſes or ſaves every year?

Rule. See what £.5 - 15*s.* *per* day amounts to in a year, and take it out of his yearly income £.2000; this ſhews what he ſaves; but if his expences be more, take £.2000 from that, and the remainder is what he loſes.

Day £. *s.* *Days*
If 1 —— 5 - 15 —— 365
20   115

115   1825
4015

2|0)4197|5 ſhillings

Yearly expences £.2098 - 15

Yearly expences —— £.2098 - 15
Eſtate —— —— 2000 -

He loſes yearly —— £.98 - 15 *Anſ.*

Queſt. 8. A farmer agreed with his ſervant to threſh all the corn he had, and the ſervant was to receive a guinea for every 7 quarters; now, he threſhed in all 15 loads 1 quarter, and has received of his maſter, at different times, by caſh and goods, 9 guineas; I demand how the reckoning ſtands between them?

Rule. Firſt, ſee what 15 loads 1 quarter come to, at a guinea, or 21 ſhillings for 7 quarters, and then ſubtract 9 guineas out of it.

qrs. *ſhill.* *loads* *qr.*
If 7——21——15 - 1
5 *qrs.* 1 load

76 *qrs.*
21

76
152

7)1596

2|0) 22|8 ſhillings

£.11 - 8 *Anſ.*

Servant's wages for threſhing	£.11 - 8
He received 9 guineas, *viz.* ——	9 - 9
Due to the ſervant ——	£.1 - 19 *Anſ.*

Queſt. 9. A corn-factor ſends to his correſpondent in *Spain*, 10,000 quarters of wheat, and agreed at £.8 - 7 - 6 per load, and he has received by ſeveral remittances £.10,000; what is ſtill due to him?

Load £. *s.* *d.* *qrs.*
If 1——8 - 7 - 6——10,000
5 20

5 *qrs.* 167
12

2010 pence
10000

Firſt number 5)20100000

12)4020000 pence

2|0) 33500|0 ſhillings

£. 16750 *Anſ.*

Wheat	£.16750
Received	10000
Due to him	£.6750

Queſt. 10. Bought 4 bags of hops, which weighed as under

No.	C.	qrs.	lb.
1	2	3	11
2	1	2	27
3	2	1	17
4	1	3	15
	8	3	14

And gave after the rate of 5 guineas *per cwt.* what do they come to?

C.	£. s.	C. qrs. lb.
If 1	5 - 5	8 - 3 - 14 **
112 *lb.*	20	4
112 *lb.*	105	35 *qrs.*

28

284
71

994 *lb.*
105

4970
9940

Firſt number 112)104370(931 ſhillings divided by 20, is 46 - 11. So that the anſwer is 46 - 11 - $10\frac{1}{2}$.
1008

357
336

210
112

98 remainder
12

112)1176(10 pence
112

56 remainder
4

112)224(2 farthings
224

0

** *Note*, I reduce the firſt and third into *lbs.* and the ſecond into ſhillings, and the quotient is ſhillings, and the remainder 98 I multiply by 12, and divide by the ſame diviſor, (*viz.* 112) and it gives 10 pence in the quotient; and the next remainder I multiply by 4, and it gives 2 farthings.

** ☞ See a ſhorter way than either this, or page 104, to bring *cwts. qrs.* and *lbs.* into *lbs. viz.* in example 1; in Tare and Tret.

Queſt. 10. There is a ſhip worth £.2000, of which I have the $\frac{7}{32}$ parts, I demand what my ſhare is worth?

Firſt, according to the common order of the Rule of Three, I ſay,

```
 Parts                     Parts
If 32 be——£.2000, what is 7
                 7
          ————
   32)14000(437 pounds
      128
      ————
       120
        96
       ———
        240                          Ans. £.437 - 10s.
        224
       ————
         16 remainder
         20 ſhillings
       ————
   32)320(10 ſhillings
       ———
         0
```

Note, I multiply the remainder 16 by 20, and divide by the ſame *diviſor* 32, and the quotient is ſhillings. Had any thing remained, I ſhould now have multiplied it by 12, and divided by 32, and the quotient would have been pence, &c.

Note, It often happens, that dividing by the parts is both ſhorter and eaſier than dividing by the whole: nothing but practice and obſervation can make a man maſter of this; for ten thouſand rules without theſe are of very little account.

OBSERVATION.

Here, according to the nature of the queſtions of *Multiplication* or *Diviſion of Money*, I perform the above queſtion with eaſe.

Parts — *Parts*

If 32————£.2000————7

7

8 times 4 is 32 by 8)14000

4)1750

Anſ. £.437 - 10

Here I divide by 8, and by 4; when I divide by 4, I find 2 remain, which I call 2 pounds: then I ſay, the 4th part of £.2 is 10 ſhillings.—And now you may ſee the beauty of *Multiplication* and *Diviſion of Money*, if you do but obſerve it well.

Tyro. I humbly thank you, ſir, and ſee there is nothing like knowing the former rules perfectly.

Philo. As I ſaid before, many queſtions may be performed by *Multiplication* and *Diviſion of Money*, if they be rightly applied, and much ſhorter and eaſier than the common order of the *Rule of Three*. I ſhall give you one inſtance, and no more, which, if well obſerved, will be ſufficient; for according to the nature of the queſtion, a great many figures may be ſaved, as well as trouble.

Queſt. 11. Bought a box of ſuperfine tea, which weighed 2 *qrs.* 7 *lb.* and gave £.73 - 12 - $7\frac{1}{2}$ for it; what is 5 *lb.* of it worth?

Firſt, and common Way.

qrs. *lb.* — £. *s.* *d.* — *lb.*
If 2 - 7 —— 73 - 12 - $7\frac{1}{2}$ —— 5
28 — 20
63 — 1472 ſhillings
12
17671 pence
4
70686 qrs.
5 third number
63)353430(5610 farthings
315
384
378
63
63
0

Farthings
4)5610
12)1402-$\frac{1}{2}$
2|0) 11|6-10
Anſ. 5-16-$10\frac{1}{2}$

Short Way, by Multiplication *and* Diviſion of Money.

lb. £. *s.* *d.* *lb.*
If 63 —— 73 - 12 - $7\frac{1}{2}$ —— 5
5
63 is 9 times 7)368 - 3 - $1\frac{1}{2}$
9) 52 - 11 - $10\frac{1}{2}$
5 - 16 - $10\frac{1}{2}$ *Anſ.*

Here you ſee that the ſecond way has but about half the figures.

Tyro. I ſee it very plainly; and I think I am able to do any common ſum of but one *ſtating*.

Philo. Then we will proceed to *Section* 4.

SECTION IV.

Containing ſome neceſſary Directions in more difficult Queſtions, and ſuch as require more than one ſtating.

Tyro. HOW am I to manage when the *firſt* and *third* numbers are not of one name or denomination?

Philo. Bring them into one denomination (according to *direction* 2, *ſection* 1) and proceed by multiplying your *ſecond* by the *third*, and divide by your *firſt*, as before.

Queſt. 12. If 3 yards coſt 8*s.* 3*d.* what coſt 96 ells *Engliſh?*

```
   Yards        s.  d.      Ells Engl.
   If 3 ————————8 - 3——————————96
      4         12              5
      —         —           —————
     12         99            480
                               99
                           ——————
                             4320
                            4320
                           ——————
       Firſt number     12)47520
                        ————————
                        12) 3960 pence
                        ————————
                        2|0) 33|0
                        —————————
                          £.16 - 10 Anſ.
```

Rule. Here, becauſe the *firſt* number is yards, and the *ſecond* ells *Engliſh*, I bring them both into quarters, by multiplying the yards by 4, and the ells by 5, and then proceed as before.

Firſt Proof, or Variation.

Queſt. 13. If 96 ells *Engliſh* coſt £.16 - 10*s.* what coſt 3 yards?

Ells	£. *s.*	*Yards.*
If 96	16 - 10	3
5	20	4
480 qrs.	330 ſhillings	12 qrs.

330 ſhillings
12

3960 pence
12 third number

Firſt number 480)47520(99 pence. *Anſ.* or 8*s.* 3*d.*
4320

4320
4320

0

☞ Here you ſee the *fourth* number, or anſwer, is the ſame as the *ſecond* number in the laſt queſtion. See the next queſtion.

Second

Second Variation, or Proof.

Queſt. 14. If I buy 3 yards of Holland for 8*s.* 3*d.* how many ells *Engliſh* may I have for £. 16 - 10?

☞ Here, becauſe the anſwer is to be in meaſure, therefore meaſure muſt be my ſecond number, thus:

s. *d.* *Yards* £. *s.*
If 8 - 3 —— 3 ——— 16 - 10
12 20
— ——
99 pence 330 ſhillings
12
———
3960 pence
3 ſecond number
———
Firſt number 99)11880(120 yards
99
———
198 *Yards.*
198 120
——— 4 qrs. 1 yard
0 ———
Qrs. 1 ell 5)480 qrs.
———
96 ells. *Anſ.*

☞ Here you ſee I do not bring the ſecond number, yards, into quarters, as I did before in the other two queſtions, for it is better to work with it as it is; becauſe it ſaves a great many figures, and the anſwer will be 120 yards, which I reduce into ells very eaſily, by multiplying by 4, and dividing by 5; and if you conſider all the three different ways of working this queſtion, it will be of great ſervice to you.

Queſt. 15. A draper bought 12 pieces of Holland, each piece containing 23 ells *Engliſh*, and gave after the rate of 3*s.* 4*d.* per ell *Flemiſh*; what did they come to?

First, 23 ells 1 piece
12 pieces
276 ells in all.

Ell Flem. *s.* *d.* *Ells Eng.*
If 1 —— 3 - 4 —— 276
3 qrs. 1 ell *Fl.* 12 5
3 40 pence 1380 qrs.
40
3)55200
12)18400 pence
2|0) 153|3 - 4
£. 76 - 13 - 4 *Anſ.*

Tyro. I am obliged to you; and now, if you pleaſe, I will try at one.

Philo. With all my heart; I like to ſee you in this mind.

Queſt. 16. A woollen-draper bought 4 packs of cloth, each pack containing 3 parcels, each parcel 6 pieces, and each piece 40 yards, and gave 3*l.* 10*s.* for every 6 yards, one with another; what do they come to?

Tyro. Firſt, I ſee how many yards there are in all, by multiplying them together as they ſtand, thus:

4 packs
3
—
12 parcels
6
—
72 pieces
40
—
2880 yards in all

Yards £. *s.* *Yards.*
If 6—3 - 10—2880
20 70
— —
70 6)201600 ſhillings
—
2|0)3360|0
—
1680 *Anſ.*

Philo. Very right; and you may prove this ſum ſeveral ways at leiſure, which will be of ſervice. Firſt, £. 3 - 10*s.* every 6 yards is 11*s.* 8*d.* for 1 yard. Therefore ſay, if 1 yard coſt 11*s.* 8*d.* what coſt 2880, and it will be the ſame anſwer. And again, you know 2880 yards, at £. 1 per yard, is £. 2880; therefore ſay, if 20 ſhillings be 11*s.* 8*d.* what will 2880 be; and you will have 1680 for anſwer, as before.

Queſt. 17. How many dozen of candles, at 5*s.* 3*d.* per dozen, may I have in *exchange* for 3 pieces of *Iriſh*, each 20 ells long, at 3*s.* 9*d.* per yard?

Here are two ſtatings in this queſtion; firſt, ſee what the *Iriſh* comes to, and as the queſtion aſks, how many dozen of candles, therefore 1 dozen muſt be the *middle* number of the ſecond ſtating.

Firſt, 3 pieces, each 20 ells, is 60 ells in all.

```
Yard    s. d.    Ells      s. d.  Doz.       £.  s. d.
If 1 —— 3 - 9 —— 60.   If 5 - 3 buy 1 —— 14 - 1 - 3
   4    12        5      12                  20
   —    ————      ——     ——                 ————
   4    45       300     63                  281
        300                                   12
      ————                                  ————
   4)13500                              63)3375(53 dozen
      ————                                  315
  12) 3375 pence                            ————
      ————                                   225
 2|0) 28|1 - 3                               189
      ————                                  ————
       14 - 1 - 3 Iriſh coſt                  36
                                              12 in 1 doz.
                                            ————
                                        63)432(6 candles
                                            378
                                            ————
                                             54
```

Anſwer, 53 dozen and 6, that is, 53 dozen and a half: the remainder 54, and all other remainders, are placed fraction-wiſe over the *diviſor*, thus, $\frac{54}{63}$. So that the true anſwer is 53 dozen and 6 candles, and 54 ſixty-three parts of another candle, or $\frac{6}{7}$, which wants but $\frac{1}{7}$ of another whole one.

Tyro. I underſtand it all but the $\frac{6}{7}$, how do you make that out?

Philo. You will ſee better when you come to *Vulgar Fractions*; for $\frac{6}{7}$ is the ſame as $\frac{54}{63}$. For divide the *numerator*

merator 54 by 9, and it is 6, for a *new numerator*, and divide 63, the *denominator*, alſo by 9, and it is 7. But the anſwer without the fraction is near enough, and you muſt not mind theſe curioſities at preſent.

Queſt. 18. A woollen-draper bought a certain quantity of ſerge and broad-cloth for £. 500: the quantity of broad-cloth he bought was 500 yards, at 12*s.* 6*d.* *per* yard; now he bought 3 times as many yards of ſerge as he did broad-cloth. I demand how much each coſt, and what the ſerge coſt *per* yard?

First, I find what the broad-cloth comes to.

Yard *s.* *d.* *Yards*
If 1——12 - 6——500
12

150
500

12)75000

2|0)625|0 ſhill.

£. 312 - 10 *Anſ.* broad-cloth

	£.
Both of them coſt	500 -
Broad-cloth coſt	312 - 10
The ſerge coſt	187 - 10

Here you ſee the broad-cloth coſt in all £.312 - 10*s.* which taken out of £.500 (what they both coſt) the ſerge then muſt coſt in all £.187 - 10*s.* Now the queſtion ſays, he had three times as many yards of ſerge as he had of broad cloth, which is in all 1500 yards (that is, 3 times 500) of ſerge. Then to find how much the ſerge coſt *per* yard, I ſay,

Yards £. *s.* *Yard.*
If 1500 coſt 187 - 10——1
20
3750
12
Firſt number 15|00)450|00(30 pence, or *2s. 6d.* *Anſ.* the ſerge coſt *per* yard.
45
0

Tyro. Sir, I am highly obliged to you; and I perceive, that it is nothing elſe but conſidering the nature of the queſtion, and two ſtatings are as eaſily done as one. But pray, if I may be ſo free, is not Intereſt caſt up, or done by the *Rule of Three?*

Philo. There is a ſhorter way of doing it; but it may be done very eaſily; as alſo, *exchange*, *loſs* and *gain*, *barter*, *fellowſhip*, and many ſuch like rules, tho' they bear thoſe different names, are all but the *Rule of Proportion*; however, to ſatisfy you, I will give you an example or two of each, to prepare you the better to work them.

1. *An* EXAMPLE *in* INTEREST

Queſt. 19. What is the intereſt of £.360, for three years, at $3\frac{1}{2}$ (or £. 3 - 10*s.*) *per cent. per annum?*

Note, Remember that *per cent.* ſignifies £. 100; ſo that in other words it is thus: What comes the intereſt of £.360 to for three years, at £.$3\frac{1}{2}$ for every £.100? Say,

£. £. *s.* £.
If 100——3 - 10——360
20 70
70 1|00)252|00
2|0)25|2 ſhillings
£. 12 - 12 for a year. *Anſ.*
3 years multiply
£. 37 - 16 for 3 years. *Anſ.*

And after this manner any ſum, at any rate *per cent.* may be done.

Note, When there are odd months, you muſt allow in proportion, thus: Suppoſe it had been ſix months more, you ſee one year, or twelve months, is £. 12 - 12*s.* therefore ſix months is half of it, viz. £.6 - 6*s.* and three months is £. 3 - 3*s.* more.

Queſt. 20. A perſon left his niece £.650, to be paid to her when ſhe came to proper age, with intereſt upon it, at 4 *per cent.* Now it lay in the executor's hands 219 days, what had ſhe got to receive, principal and intereſt together?

First, I find the intereſt for one year.

£. £. £.
If 100—4—650
4
£. 26|00

I cut off 2 cyphers, which is the ſame as if divided by 100, and the anſwer is £.26 for one year's intereſt.

Principal —— £. 650 -
219 days intereſt is 15 - 12

Anſ. She has £. 665 - 12 to receive.

Days £. *Days.*
If 365 be 26——219
26
1314
438
365)5694(15£.
365
2044
1825
219
20
365)4380(12*s.*
365
730
730

2. *An* EXAMPLE *in* bartering, *or* exchanging. See Queſtion 17.

Queſt. 21. Two merchants. *A* and *B*, *barter* or *exchange* with one another in traffic. *A* has ſugar, which he ſells at £. 4 *per cent.* for ready money; but in *barter* he will have £. 4 - 13 - 4. *B* has wine at £. 13 *per* hogſhead; now the queſtion is, how much *B* ought to advance his wine in *barter*, to equal the advance of *A*'s ſugar.

Firſt, ſugar —— £.4 - 13 - 4 in *barter*
For ready money —— 4 - -

£. - 13 - 4 advance

£. s. d. £.
Then, If 4 advance 13 - 4 —— 13
12

160
13

480
160

Firſt number 4)2080

12)520 pence

2|0) 4|3 - 4

£. 2 - 3 - 4 *Anſ.*

Anſ. *B* muſt advance his wine £. 2 - 3 - 4: So that in *barter* his wine is worth £. 15 - 3 - 4 *per* hogſhead.

3. EXAMPLES *in* Profit *and* Loſs, *or* Loſs *and* Gain.

Queſt. 22. Bought 3 pipes of Wine for 100 guineas, one of which leaked or ran out 23 gallons; the remainder I ſold at the rate of 3 half crowns per gallon, what was my gain or loſs?

Firſt, 1 pipe is 126 gallons
3
3 pipes are 378 gallons
23 leaked out
355 gallons left

Gall. *s.* *d.* *Galls.*
If 1—7 - 6——355
12 90
90 12)31950
2|0) 266|2-6
Sold for £.133-2-6

Made of the whole £. 133 - 2 - 6
Coſt 100 guineas, *viz.* 105 - -
Gain —— £. 28 - 2 - 6 *Anſ.*

Queſt. 23. What is gained *per cent.* that is, what is gained in laying out £. 100, when 1*s.* brings in 14*d.* ¾?

Firſt, 14*d.* ¾
1 ſhilling 12
1 ſhilling gains 2¾

d. *d.* £.
If 12 gain 2¾—100
4 20
11 2000
12
24000 pence
11
12)264000
4)22000
12)5500
2|0) 45|8 - 4

Gained *Anſ.* £. 22 - 18 - 4

Queſt. 24. A gentleman that ſaw very plainly he could not live upon the common intereſt of his money, ſet up as a common brewer, and laid out £. 1000 for that purpoſe, in fitting up an office, and buying utenſils; the hops, malt, exciſe, wages, and other charges at the year's end amounted to £.4000 more; in which time he ſold out as much beer as came to £.6875. I demand what he gained in all, and how much he gained *per cent.*

Firſt, Beer amounted to —— £.6875
His charges are —— 5000

Gained in one year —— 1875

£. £. £.
If 5000 gain 1875 —— 100
100

* 5|000)187|500

£. 37—2500 remains
20

5|000)50|000

10 ſhillings

Anſ. He gained in all £.1875, which is £.37 - 10*s.* *per cent.*

* *Note*, I cut off three cyphers in the *diviſor*, and three figures in the *dividend* to anſwer them: then I divide 187 by 5, and it is 37, and 2 over, which I place before the 500 that I cut off, and it makes 2500 remain, which I multiply by 20, and cut off three cyphers, and divide by 5 only, gives 10 ſhillings.

4. EXAMPLES *in* COMPANY *called* FELLOWSHIP.

Queſt. 25. Two tradeſmen or merchants, *A* and *B*, enter into partnerſhip, and purchaſe one common ſtock. *A* put in £.1750, and *B* put in £.1050, and they gain the firſt year of trading £.800 clear; what is the ſhare of each, according to the ſum each advanced at firſt?

Rule. In all queſtions of this nature the rule is, Add together what every perſon firſt put into ſtock, and then ſay, as the *whole ſtock* is to the *gain* or *loſs*, ſo is what every perſon ſeparately put in, to his particular *gain* or *loſs*. That is, the *whole ſtock* added together is your *firſt* number; the *gain* or *loſs* your *ſecond* number; and what every man ſeparately put in is your *third* number; and the different anſwers, or *fourth* number, will be every man's proper ſhare.

The Work.

A put in —— —— £,1750
B put in —— —— 1050

Whole ſtock —— —— £.2800

£. £. £.
If 2800 gain 800 —— 1750 *A*'s ſtock
800

28|00)14000|00(500£. *A*'s gain
140

00

Secondly, If 2800 gain 800 —— 1050 *B*'s ſtock.
800

28|00)8400|00(300£. *B*'s gain.
84

00

Anſ. *A*'s ſhare of the gain is — £.500
B's ſhare is —— 300

Gain — —— 800 proof

☞ *Note*, If the *gain* or *loſs* be pounds, ſhillings, and pence, reduce it accordingly, and your anſwer will be of the ſame name; and if there be remains, add them together, and they will be always equal to the *diviſor* if the work be right, and you muſt carry one to the next denomination when it happens ſo.

Queſt. 26. A perſon broke, in debt, for £.1890; but he gave up all his effects to his creditors, which amounted to £.661 - 10*s*. how much then did each creditor receive in the pound?

Note, Had each perſon's debt been ſpecified, there muſt have been as many different ſtatings, but in this caſe but one, thus:

```
     £.        £.    s.   £.
If 1890 be 661 - 10 —— 1
                 20
             ———————
1890)13230(7 ſhillings in the pound.  Anſ.
     13230
     —————
         0
```

P R O O F.

```
Debt £.1890
          7
      ————
  2|0)1323|0
      ————
£.661 - 10 effects.
```

Now, ſuppoſe, for example's ſake, that any creditor's debt or demand was £.58, what muſt he receive? Say, if £.1 be 7 ſhillings, what will £.58 be, and you will find it £. 20 - 6 for his part; and ſo for the others, be they more or leſs.

Tyro. I am extremely obliged to you for your explaining things to me in this manner.

Philo. I have no other aim but your advantage; nor ſhould I have been ſo long and particular, but that your knowledge in this *rule* is the foundation of all the higher rules, and even of the *mathematics* itſelf. Thouſands of examples more, 'tis true, might be given you; but as they depend upon what you have ſeen, and your conſtant practice, I ſhall give you but one more, which in ſome meaſure varies from the former ones.

Queſt. 27. A woollen-draper bought of a clothier, an equal quantity of four ſorts of cloth, which coſt him £.367 - 10*s.* Some coſt 18*s.* 6*d.* ſome 14*s.* 3*d.* ſome 11*s.* 6*d.* and ſome 4*s.* 9*d.* *per* yard: how many yards of each had he?

Rule. The method of working all ſums of this ſort is this: add all the different prices together into one ſum, which is the *firſt* number; then 1 yard, or 1*lb.* &*c.* will be your *ſecond* number, and the whole ſum laid out your *third* number.

The Work.

Firſt, I add all the different prices, thus:

	s.	*d.*
	18	6
	14	3
	11	6
	4	9
£.	2 - 9	-

£. *s.* *Yard* £. *s.*

If 2 - 9 —— 1 —— 367 - 10

20 20

49 ſhillings 49)7350(150 yards of each *Anſ.*

49

245

245

0

Tyro. I perceive the nature of it plainly.

Philo. Indeed, *Tyro*, if you underſtand theſe examples, you are able to ſolve any common queſtion relating to buſineſs.

N. B. My intent, *Tyro*, was to have given you here a notion of *timber*-meaſure, and how to *gauge* a common caſk, cooler, or piece of malt, *&c.* or to meaſure any regular piece of ground; it being not only diverting, but alſo uſeful in the country, and very ſatisfactory to parents, when their children have ſome knowledge of theſe things. But I ſhall reſerve this for a dialogue by itſelf, and only leave you a few queſtions for practice.

QUESTIONS *to exerciſe the Learner in the* RULE OF THREE.

28. The rents of a whole pariſh amount to £.1750, and a rate is granted of £.32 - 16 - 3; what is that in the pound? *Anſ.* 4*d.* ½.

29. A bankrupt is indebted £.2980 - 10*s.* but all his effects amount but to £.931 - 8 - 1½; what have his creditors in the pound? *Anſ.* 6*s.* 3*d.*

30. Bought a lighter of coals, containing 33 chaldrons, 12 buſhels, for which I gave £.50; what do they lie me in *per* buſhel? *Anſ.* 10*d.*

31. Bought of a goldſmith 4 *lb.* 11 *oz.* 10 *dwts.* of plate, at 5*s.* 4*d.* *per* ounce; what does it come to? *Anſ.* £. 15 - 17 - 4.

32. What is the intereſt of £.631 - 5*s.* for a year, at 3 *per cent?* *Anſ.* £. 18 - 18 - 9.

33. What comes the commiſſion of £.245 - 6*s.* to, at 2½ *per cent?* *Anſ.* £. 6 - 2 - 7¾, ⅕.

34. What muſt I give for the $\frac{6}{32}$ parts of a ſhip, that is worth £. 635 - 5*s.* *Anſ.* £. 119 - 2 - 2¼.

35. Shipped for *Barbadoes* 500 pair of ſtockings, at 3*s.* 6*d.* *per* pair, and 1650 yards of baize, at 15*d.* *per* yard; and I have received in return 348 gallons of rum, at 6*s.* 8*d.* *per* gallon, and 750 *lb.* of indigo, at

1*s.* 6*d. per lb.* what remains due upon my adventure? *Anſ.* £. 18 - 7 - 6.

Rule. See what the ſtockings and baize come to, and add them together; then ſee what the rum and indigo both come to, and ſubtract it from the other, when you will find the anſwer as above.

36. How many bricks, 9 inches long, and 4 inches wide, will floor a room 18 feet ſquare; that is, 18 feet wide, and 18 feet long.

Rule. Firſt, find the content of the room in ſquare feet, that is, multiply the length by the breadth; then multiply that product by 144, which will bring it into ſquare inches: this done, multiply the length of the brick by the breadth, and you will have 36 inches, which is your diviſor, and the anſwer is 1296 bricks.

37. How many 10 inch tiles will floor a malt kiln 16 feet long, and 14 feet wide. *Anſ.* 322 $\frac{56}{100}$.

Rule. Multiply 10 by itſelf, gives the contents of one tile in ſquare inches; then find the contents of the room in inches, and divide by 100, it is 322, and better than a half.

38. Bought a ton of iron, which coſt £. 19 - 10*s.* there being in number 32 bars: I deſire to know the price of each, and what they weighed one with another? *Anſ.* 12*s.* 2*d.* $\frac{1}{4}$, and each bar weighs 2 *qrs.* 14 *lb.*

39. There is a ciſtern that holds 4 hogſheads of water (allowing 63 gallons to the hogſhead) in which are placed two pipes, the larger of which will diſcharge $1\frac{1}{2}$ gallon every minute; but if they both be ſet open, they will diſcharge $2\frac{1}{4}$ gallons every minute: I demand in how long time the ciſtern will be filled by each pipe alone, and in how long when they are both ſet open together. *Anſ.* Greater pipe will fill it in 2 hours 48 minutes; the ſmall one in 5 hours 36 minutes; and both in 1 hour 52 minutes.

40. There is a ſteeple, which ſtands right upon level ground, whoſe ſhadow meaſures 75 yards, at the ſame time that the ſhadow of a ſtrait walking-ſtick,

which is a yard long, meaſures 5 feet: I demand the height of the ſteeple? *Anſ.* 45 yards.

41. As I was beating on the foreſt grounds,
Up ſtarts a hare before my two greyhounds;
The dogs being light of foot, did fairly run
Unto her 15 rods, juſt 21.
The diſtance that ſhe ſtarted up before
Was 4 ſcore 16 rods juſt, and no more:
Now this I'd have you unto me declare,
How far they ran before they caught the hare?
Anſ. 336 rods.

DIALOGUE VIII.

SECTION I.

The RULE OF THREE INVERSE;

Or, Reciprocal Proportion.

Tyro. WHAT do you mean by the *Rule of Three Inverſe?*

Philo. It is often called the *Rule of Three Reverſe*; that is, it is contrary to the *Rule of Three Direct*. For, as in the *Rule of Three Direct* you multiply your *ſecond* number by your *third*, and divide by your *firſt*; here you multiply your *ſecond* by your *firſt*, or your *firſt* by your *ſecond*, and divide by your *third*, and the *fourth* number is the anſwer.

Note, Your *third* and *firſt* number muſt be of the ſame name or denomination as in the *Rule of Three Direct*, and the *fourth* number, or anſwer, will be of the ſame name as the ſecond number.

Queſt. 1. How many yards of ſhalloon, 3 qrs. wide, will line 4 yards of cloth, which is 5 qrs. wide? *Anſ.* $6\frac{2}{3}$ yards.

As in the *Rule of Three Direct*, ſo here alſo, the *queſtion*, or demand, lies upon the *third* number.

qrs. *yards* *qrs.*
If 5 —— 4 —— 3
5 firſt number
—
3)20
—
Anſ. $6\frac{2}{3}$

Anſ. 6 yards, and 2 remains, which I place a-top of the 3, thus $\frac{2}{3}$, and it is 2-thirds: ſo is the anſwer $6\frac{2}{3}$ yards.

Queſt. 2. If when wheat is 3*s.* 6*d.* a buſhel, the threepenny loaf weighs 4 *lb.* 2 *oz.* what ought it to weigh when the wheat is 5*s.* a buſhel? *Anſ.* 2*lb.* 11*oz.*

s. *d.* *lb.* *oz.* *s.*
If 3 - 6 ———— 4 - 2 ———— 5
12 12 *oz.* 1 *lb.* troy 12
— — —
42 pence 50 60
42
—
100
200
—
6|0)210|0
—
12)35 *oz.*
—
2 *lb.* 11 *oz.* *Anſ.*

Queſt. 3. A regiment of ſoldiers, conſiſting of 1000 men, are to have new coats, each containing 3 yards, 2 qrs. of cloth, that is 6 qrs. wide, and they are to be lined with ſhalloon that is yard wide; how much cloth will it take for their cloaths, and how much ſhalloon will line them? *Anſ.* 5250 yards.

Firſt, ſee how much is in their cloaths, thus;

Yds. qrs.
1 coat is 3 - 2
4
that is 14 *qrs.*
1000
14000 *qrs.* in all.

qrs. — *qrs.* — *Yard.*
Then, if 6 —— 14000 —— 1 ſhalloon
6 — 4
Third number 4)84000 — 4 *qrs.*
4)21000 *qrs.*
5250 yards *Anſ.*

Queſt. 4. An acre of land contains (according to the table) 40 rods in length, and 4 in breadth, what muſt be the length to make an acre, when the breadth is 15 rods?

Breadth *Length* *Breadth*
If 4 —— 40 —— 15
4
15)160(10 rods
15
10
5½ yards 1 rod
15)55(3 yards.
45
10
3 feet
15)30(2 feet
30
0

Rods Yds. Feet
Anſ. 10 - 3 - 2

Queſt. 5. If £. 100 in 12 months gain £. 4 intereſt, what principal will gain as much in 8 months? *Anſ.* £. 150.

Months £. *Months*
If 12 —— 100 —— 8
12
8)1200
£. 150 *Anſ.*

Queſt. 6. An army of ſoldiers, conſiſting of 800, beſiege a town, having with them proviſions for three months; but as they cannot take the town in that time, the General is willing to make the ſame proviſions laſt five months, allowing each man the ſame daily proviſion: the queſtion is, how many men muſt there be, that the proviſion may laſt them five months?

Months *Men* *Months*
* If 3———800———5
3
5)2400
480 *Anſ.*

Men
800 for 3 months
480 for 5 months
320 diſcharged

The laſt QUESTION *varied.*

* *Note*, This queſtion is ſet in words on purpoſe, *Tyro*, to puzzle you; but you muſt obſerve, that in all ſuch ſort of ſums, the circumſtance of what is done is never to be minded; for, ſuppoſe I ſhould ſay thus:

If 800 men in three months eat 10000 penny loaves, how many will eat the ſame in five months, at that rate? *Anſ.* 480 men as before; ſo that the action or circumſtance of what they do is nothing, let it be eating, drinking, or any other thing.

Tyro. I underſtand you, ſir, and thank you for this obſervation; and I think you have given me ſufficient examples.

Philo. All other queſtions are done after the ſame manner. If you are perfect in theſe, you will eaſily do the following ones.

QUESTIONS *to exerciſe this* RULE.

Queſt. 7. If when wheat is ſold for 3*s.* 9*d.* a buſhel, the ſix-penny loaf weighs 5 *lb.* 10 *oz.* how much ought it to weigh when it is half a crown a buſhel? *Anſ.* 8 *lb.* 9 *oz.*

Queſt. 8. How many yards of matting, that is 2 feet wide, will cover a room 20 feet long, and 18 feet wide. *Anſ.* 180 feet, or 60 yards.

Queſt. 9. How many yards of paper, three quarters wide, will be ſufficient to hang a room that is 24 yards round, and 4 yards high? *Anſ.* 128 yards.

Tyro. Theſe queſtions are ſufficient, ſir.
Philo. Then we will proceed to *Section* 2.

SECTION II.

Of PLURAL PROPORTION;

CALLED

The DOUBLE RULE OF THREE DIRECT.

Tyro. WHAT is *Plural Proportion*, or the *Double Rule of Three Direct?*

Philo. *Plural Proportion* is when five numbers are given to find a ſixth, which ſixth number, or anſwer, is found by two ſtatings of the *Single Rule of Three Direct.*

Tyro. This is very difficult, I imagine; for how am I to know how to make the firſt ſtating?

DEFINITION *and* RULE.

Philo. In every regular ſum in the *Double Rule of Three Direct*, the firſt three numbers always ſhew the condition, or ſuppoſition; and the other two, that is, the two laſt, ſhew the demand. The anſwer of the queſtion will always be the ſame as the *middle* number; and the *firſt* and *third* muſt be of the ſame name in both ſtatings, like as in the *Single Rule of Three Direct.*

Tyro. Cannot theſe queſtions be done at one ſtating?

Philo. Yes, by a rule generally called the *Rule of Three of Five Numbers*, and that with a great deal more eaſe, as you ſhall ſee by and by; but we will give an example here.

Queſt. If £.100 in 12 months gain £.4 intereſt, what will £.175 gain in 9 months? *Anſ*. £.5 - 5*s*.

£. £. £.
Firſt, If 100 gain 4 what will 175
4
1|00)7|00
£. 7

Here I find £.175 gains £. 7 in twelve months, therefore I ſay in the ſecond ſtating,

Months £. *Months*
If 12——7——9
9
12)63
£. 5———3 remains
20
Same diviſor 12)60
5 ſhillings

Or thus:

You may begin with the *ſecond*, *third*, and *fifth* numbers.

Months £. *Months.*
Firſt, If 12—be—4———9 *Anſ*. £.3

£. £. £.
Then, If 100——3——175 *Anſ.* £. 5 - 5.

Note, See the proof of this queſtion in the firſt example of the next *Rule Inverſe*.

Queſt. 2. If 600 ſeamen in one week eat 1500*lb.* of beef, how many pounds will ſerve 120 ſeamen 12 weeks? *Anſ.* 3600 *lb.* See *Example* 2, in the next rule.

All queſtions in this rule being done after the ſame manner, I ſhall leave other examples for the *Rule of Three of Five Numbers*, by which they are done with more eaſe; and ſhall only give you a notion of ſtating queſtions here and in the *Double Rule of Three Inverſe*.

A RULE *to ſtate, or know the Nature of a Queſtion, and to know the Certainty of your three firſt Numbers, and the Name of the Anſwer.*

You know there are five numbers given to find out a *ſixth*; mind then you carefully obſerve what name your anſwer is to be in: this being done, place your five numbers in two rows, *viz.* three in the firſt row, and two under them, leaving a blank ſpace under that number which is of the ſame name as your anſwer is to be in; ſo will you ſee both here, and in the next rule, the order of both theſe *Double Rules of Three Direct and Inverſe*.

Take the firſt queſtion, where your anſwer is to be in pounds, and rank the numbers thus, as the queſtion itſelf runs.

If £. 100—12 months—£. 4.
£. 175—9 months *

* Here you ſee the blank or vacant place is *money*: therefore, money muſt be your middle number of the three, and money will be the anſwer.

Note, The blank muſt fall under the ſuppoſition, which here is £. 4.

Second QUESTION.

If 600 ſeamen—1 week——1500 *lb.*

120 ſeamen——12 weeks *

* This third number in the ſecond row has a blank place under, you ſee, according to the order of the ſum; therefore 1500 *lb.* muſt be your *ſecond* number in the firſt ſtating, and your anſwer will alſo be *lbs.*

Tyro. I humbly thank you, ſir.

Philo. There are many other ways of varying this rule: but this is ſufficient for your purpoſe at preſent. See the *Rule of Five Numbers.*

SECTION III.

The DOUBLE RULE of THREE INVERSE; *called alſo* PLURAL PROPORTION.

Tyro. WHAT is the difference between this Rule and the laſt?

Philo. A great deal: for though here be *five* numbers given to find a *ſixth*, yet you will find it much more difficult to ſtate the queſtion here than in the other; but obſerve the following direction.

RULE.

1. As in the *Double Rule Direct*, ſo alſo here are three numbers in the ſuppoſition, and two in the demand.

2. Place the numbers in order, as in the laſt rule, *viz.* three in one row and two in the next, leaving

that number with a blank place under, which will be the ſame name of your anſwer, obſerving well where the ſuppoſition lies.

3. This being done, you ſtate the queſtion with three numbers firſt, as before; which is wrought according to the *Single Rule of Three Inverſe.*

☞ If your firſt ſtating be *direct*, the ſecond muſt be *inverſe*; for both are never *direct*, nor never *inverſe*.

Queſt. 1. If £.100 principal * in 12 months gain £.4 intereſt, what principal will gain 5 guineas (*viz.* £.5 - 5*s.*) in 9 months? *Anſ.* £.175 principal.

* *Note*, The word *principal* ſignifies the money put out to intereſt.

Here you ſee there are three numbers in the ſuppoſition, *viz.* £.100, 12 months, and £.4; and two in the demand, *viz.* £.5 - 5*s.* and 9 months.

Now obſerve, that one of theſe two in the demand muſt be the laſt number in the *firſt ſtating*, and the other the laſt in the *ſecond ſtating*, and one muſt be always *inverſe*.

Months £. *Months*
First, *Inverſe*. If 12——100——9

Multiply £.100 by 12, and divide by 9, you have £.133⅓, *viz.* £.133 - 6 - 8. Then,

£. £. *s.* *d.* £. *s.*
Secondly, *Direct*. If 4——133 - 6 - 8——5 - 5

Here I reduce the *firſt* and *laſt* numbers into ſhillings, and the *ſecond* into pence, and by the *Rule Direct*, I find the anſwer £.175, the principal required.

2. *Or thus:*

£. £. £. s.
1. *Direct.* If 4——100——5 - 5. *Anſ.* £.131 - 5s.
Months £. s. *Months*
2. *Inverſe.* If 12——131 - 5——9. *Anſ.* £.175, as before.

Queſt. 2. If 600 ſeamen in 1 week eat 1500 *lb.* of beef, how long will 3600 *lb.* ſerve 120 men at that rate?

Men *Week* *lbs.*
Here, If 600——1——1500
3600 *lb.* * 120 men

Firſt ſtating, *Inverſe.* If 600——1——120. *Anſ.* 5 weeks.
Secondly, *Direct.* If 1500——5——3600. *Anſ.* 12 weeks.

* See the ſecond queſtion of the laſt rule.

Tyro. I underſtand it a little, but cannot ſay I am perfect in it.

Philo. It is of no great ſignification at preſent, for you will ſee more of it in the next rule.

SECTION IV.

The RULE OF THREE *compoſed of* FIVE NUMBERS.

Tyro. WHAT difference is there between this and the other two preceding rules?

Philo. Only this, that all queſtions in the *Double Rule of Three Direct* and *Inverſe*, are performed here at one ſtating.

Tyro. So you ſaid before, I remember; pleaſe therefore to give me a rule to work it by; for, I think, that is much better than the trouble of two ſtatings.

Philo. It is ſo in general, but not always; however, it is eaſier and better for the learner upon the whole; for here, as well as in the two former rules, the difficulty lies to know whether the queſtion be *direct*, or *inverſe*. This being known, the manner of ſtating the queſtion will be eaſy, and the work as eaſy.

A ſtanding Rule to ſtate Queſtions.

1. As in the *Single Rule of Three Direct*, ſo alſo here, the *middle number* governs the queſtion, and the anſwer will be of the ſame name.

2. Having noted which the *middle number* is, the other four are eaſily known; for the *two* that are in the ſuppoſition always are the *two* before the *middle number*; the other two are the demand under the *third* and *fourth* numbers.

Laſtly, Always obſerve, that your *firſt number* be of the ſame name as your *fourth*; and your *ſecond number* the ſame as your *fifth*. This being done,

1. *The Rule for all* direct *Queſtions is this:*

Multiply your *firſt* number by your *ſecond*, for a *diviſor*; then multiply your *third*, *fourth*, and *fifth* together, and divide their product by the product of the *firſt* and *ſecond*, and the quotient will be of the ſame name as the *middle number*, be what it will, and is the *anſwer*.

EXAMPLE. *The firſt Queſtion of the two laſt Rules.*

Queſt. 1. If £.100 in 12 months gain £.4 intereſt, what will £.175 gain in 9 months? *Anſ.* £.5 - 5*s.*

```
 £. Months  £.    £.  Months
If 100—12 gain 4——175——9
     12               9
   ———              ———
   1200             1575
                       4
                    ————
             12|00)63|00
                    ————
                 £.5 - 3 remains
                      20
                    ————
                   12)60
                    ————
                       5 ſhillings
```

Anſ. £. 5 - 5*s.* See the firſt example of the laſt rules.

Queſt. 2. If 600 ſeamen, in 1 week, eat 1500 *lb.* of beef, how many *lb.* will ſerve 120 ſeamen 12 weeks?

```
  Men  Week    lb.     Men  Weeks
If 600——1——1500——120——12
        1        120
      ———      ————
      600     180000
                  12
               ————
      6|00)21600|00
               ————
            3600 lbs. Anſ.
```

See *Ex.* 2, in the *Double Rule Direct.*

Another

Another Rule for the more eaſy ſtating a Queſtion.

1. *Note*, If you obſerve the two foregoing examples, they are ſtated juſt as the numbers follow one another in the words of the queſtion; but it very often happens that the numbers in the ſum lie contrary to the order they ought to be placed in; therefore, you ſhould turn the queſtion into other words, and it will be eaſier. *Or*,

2. Set all the numbers down as they run in the queſtion, writing the names over each; then conſider what your anſwer is to be in, and place that down afreſh for the *middle number*; then the *two* where the demand lies muſt be your *fourth* and *fifth*, and the other *two* your *firſt* and *ſecond* numbers; the *firſt* muſt be the ſame as the *fourth*, and the *ſecond* the ſame as the *fifth*. See the next queſtion.

Queſt. 3. If £.4 be the wages of 8 men 10 days, what will it coſt me, or what muſt be the wages of 32 men 12 days? *Anſ*. £. 19 - 4*s*.

Here, as before directed, I place the numbers after one another, thus:

£. *Men* *Days* *Men* *Days*
If 4——8——10——32——12. Wrong ſtated.

Now here the *middle number* is days, but ſhould be money, becauſe the queſtion ſays, what will it coſt me for 32 men, 12 days; therefore money muſt be my middle number, and then, *Tyro*, the true *ſtating* will appear eaſy, as follows:

Men *Days* £. *Men* *Days*
Thus *, 8——10——4——32——12. *Anſ*. £. 19 - 4*s*.

Now here, *Tyro*, the ſtating runs like the words of the ſum, as follows, which is very natural.

---

* If 8 men in 10 days coſt me £.4 for wages, what will 32 men coſt me in 12 days, at that rate? *Anſ*. as before.

Queſt. 4. (*A proof of the firſt queſtion in the laſt rule.*) A perſon put out 175 pounds to receive intereſt, and when it had continued nine months, he received principal and intereſt together £. 180 - 5. I demand at what rate *per cent. per annum* he put his money out at? *Anſ.* £. 4 *per cent. per annum.*

Here the words of the queſtion are like the *ſtating*. You muſt obſerve then to proceed as under, in all queſtions of this nature.

Rule. Take the principal from the intereſt and principal together, the remainder will be the intereſt for the time it continued, and then the ſtating will follow:

Thus, Principal and intereſt	——	£. 180 - 5*s.*
Principal put out	——	175 -
Intereſt for 9 months	——	£. 5 - 5*s.*

£. *Months* £. *s.* £. *Mths.*
If 175——9 gain 5 - 5 intereſt, what will 100 in 12

Here, according to the rule, bring your *middle number* into ſhillings; then multiply it by your *fourth* and *fifth*, for a *dividend*; this done, multiply your *firſt* and *ſecond* together for a *diviſor*, and the quotient will be 80 ſhillings, or £. 4, the rate he put the money out at.

Tyro. I heartily thank you; and I find by this I ſhall be able to anſwer Mr. *Coker*'s laſt queſtion in the *Double Rule of Three Direct*, which before always appeared very difficult to me.

Philo. You ſay very right, *Tyro*, for the queſtion is done after the very ſame manner; therefore ſhall give you only two or three examples in the *Double Rule of Three Inverſe*, and leave you to practiſe the other examples.

QUESTIONS *Inverſe.*

2. The rule for *Queſtions Inverſe* is as follows: the 3 numbers belonging to the ſuppoſition muſt be your *firſt*, *ſecond*, and *third* numbers, and the demand is your *fourth* and *fifth* number. Theſe being obſerved, the rule is, multiply your *ſecond*, *third*, and *fourth* together for a *dividend*, and your *firſt* and *fifth* together for a *diviſor*, and the *quotient* is the ſame anſwer as your *middle number*.

Queſt. 1. *(A proof to the very laſt queſtion, and of queſtion* 1 *in the laſt rule.)* If £. 100 in 12 months gain £. 4 intereſt, what principal will 5 guineas gain in 9 months?

Here as the principal is to be the anſwer, ſo the principal *(viz.* £. 100) muſt be your *middle number*:

	£. Mths.	£.		£. s.	Months	£.
If	4—12	be 100 principal,	what	5 - 5	be 9.	*Anſ.* 175.

I ſtate the queſtion according to the firſt ſtanding rule, making my *firſt* and *fourth*, and my *ſecond* and *fifth* alike; this done, I bring my *firſt* number into ſhillings, (*viz.* 80) becauſe the *fourth* muſt be brought into ſhillings: this being done, I multiply the *ſecond*, *third*, and *fourth* together, for a *dividend*, and the *firſt* and *fifth* together for a *diviſor*, and the *quotient* is £. 175, the principal required.

Queſt. 2. If 600 ſeamen in 1 week eat 1500*lb.* of beef, how long will 3600 *lb.* laſt 120 ſeamen?

	lb.	*Men*	*Week*	*lb.*	*Men*
If	1500——	600——	1——	3600——	120

Here I multiply the *ſecond*, *third*, and *fourth* together for a *dividend*, which is 2160000, and my *firſt* and *fifth* for a *diviſor*, which is 180000, and the *quotient* is 12 weeks.

Queſt. 3. If it coſt £. 240 for 60 ſervants in 8 weeks, how long will £. 140 ſerve 8 ſervants? *Anſ.* 35 weeks.

Tyro. Sir, theſe examples are ſufficient, I think.

Philo. If you are well grounded in the nature of the rule, that is enough; for you may ſet yourſelf ſums at any time by way of exerciſe. And now, *Tyro*, I will give you a notion of *Tare* and *Tret*.

SECTION V.

TARE *and* TRET.

Tyro. WHAT do you mean by *Tare* and *Tret?*

Philo. Tare and *Tret* are allowances made in buying and ſelling commodities that are liable to loſs or waſte.

Tyro. What are the general names belonging to this rule?

Philo. They are 6, *viz. groſs*, *tare*, *tret*, *ſuttle*, *cloff*, and *neat*.

Tyro. Pleaſe to explain theſe in their order.

Philo. Firſt, *Groſs*, ſignifies the whole weight of any commodity, or parcel of goods, bag, or box, or caſk, and all included: thus, ſuppoſe I had a box of tea, bag of ſpice, or caſk of oil, which weighs 120*lb.* I ſay it weighs 120*lb. groſs*.

Secondly, *Tare* is an allowance made for the weight of the box, bag, or caſk, and what hangs about it, and is to be taken out of the *groſs*, and then the remainder is called the *neat*; or *clear weight* of the commodity: thus, ſuppoſe the foregoing box, bag, or caſk, after the goods are out, ſhould weigh 16*lb.* then I ſay, I ſay, it has 16*lb*. *tare*, which I ſubtract out of the *groſs* 120 *lb*. and their remains 104 *lb*. *neat*, thus:

Bought a box of tea,	*Groſs*	120 *lb*.
	Tare	16 *lb*.
	Neat	104 *lb*.

Thirdly, *Tret* is an allowance of 4 *lb*. for every 104; that is 1 *lb*. is allowed for every 26 *lb*. for ſuch commodities as are liable to waſte, moth, duſt, &*c*.

Note, When there is *tret* in the ſum, then after the *tare* is taken from the *groſs*, the remainder is called *ſuttle*, inſtead of *neat*.

Note 2. To find the *tret* pounds, divide the *ſuttle* pounds by 26, and the *quotient* is the *tret*, which ſubtracted from the *ſuttle* gives the *neat*.

Thus, A box of tea,	*Groſs*,	120 *lb*.
	Tare	16
	Suttle	104 *lb*. which divide by 26
	Tret	4 *lb*.
	Neat	100 *lb*.

```
26)104(4 tret
   104
   ———
     0
```

Fourthly, *Suttle* pounds are ſo called (as was ſaid before) when there is *tret* in the ſum; for when there is no *tret* there is no *ſuttle*, and the *tret* pounds are always ſubtracted out of them, as in the above.

Fifthly, *Cloff* is an allowance of 2 *lb*. for every 3 *Cwt*. for the turn of the ſcale, and for ſmall draughts; but this is allowed only in ſome particular things and caſes.

Sixthly, *Neat* weight is the *clear* weight of the commodity after all the allowances are made.

Tyro. Sir, I underſtand you very well; but if I remember, you told me (in *page* 142) you would ſhew me a ſhorter method to reduce *cwts.* and *qrs.* into *lbs.* than you did in *page* 104.

Philo. I did ſo, and will now ſhew you all the ways, and leave you to take your choice.

To reduce Hundreds *and* Quarters *into* Pounds.

EXAMPLE 1.

C. qr. lbs.
Reduce 17 - 3 - 15 into *lbs.*

C. qrs. lbs.
Firſt method. 17 - 3 - 15
4

71
Common way 28

573
143

Anſ. 2003 *lbs.*

C. qrs. lbs.
Second method. 17 - 3 - 15 *
17
17
17
Add 99 for the 3 *qrs.* 15 *lb.*

Anſ. 2003 *lb.* *See p.* 104.

* *Note*, In this method you muſt always ſet the *C*'s down four times, *viz.* twice under one another, and the other two, each one place more towards the left-hand; then count how many pounds there are in the odd *qrs.* and *lbs.* (which are here 99) and always place them under the *units*, *tens*, as above, and adding them together, you have the *anſwer*.

Note, This method is ſhorter than the *firſt*, and more particular when there are many figures in the given *hundreds*.

Third method. Multiply by 112, and take in the odd pounds.

C. *qrs.* *lbs.* *C.* *lb.*
17 - 3 - 15 is 17 and 99
112 *

Anſ. 2003

* Here I multiply by 112 in one line, thus: I ſay, 12 times 7 is 84, and 9 odd *lbs.* make 93, 3 and I carry 9; then 12 times 1 is 12, and 9 I carried is 21, and the other 9 I take in alſo is 30, that is 0, and I carry 3. *Laſtly*, I ſay, once 17 is 17, and 3 I carried is 20, which I place by the ſide of the other two figures, and it is done.

This is alſo ſhorter than the *firſt method*, but ſomething more difficult till you learn to multiply by 112 very well, as you will ſee in *Ex.* 2.

☞ *Fourth method.* The beſt way (in my opinion) is this laſt method, which is this: multiply the *C*'s by 12 only, always remembering to place the two firſt figures out towards the right-hand; then ſet the odd pounds under, and add them together as they ſtand, it is done.

C. *qrs.* *lbs.* *C.* *lbs.*
Thus, 17 - 3 - 15 is 17 - 99 †
204
99

Anſ. 2003 *lbs.* as before.

There is no occaſion to ſet down the 12 under the 17, when you multiply; for it is eaſy to remember you multiply by 12. I ſay then 12 times 7 is 84, (which

---

† See the note at the top of the next page.

4 I place 2 figures towards the right-hand of the 17) that is 4 and I go 8; then 12 times 1 is 12, and 8 is 20, which I place to the left of the 4, ſo that the 2 falls under the 7; then I ſet down the 99 odd pounds, and add them together, they make 2003 *lb.*

† *Note*, But you may do it yet ſhorter by uſe, and full as eaſy, and that is by taking in the 99 as you multiply, which will ſave the trouble of adding it afterwards.

C. *lb.*
Thus, 17 - 99
303
———
2003

Here I ſay, 12 times 7 is 84, and 9 is 93, 3 and I carry 9; 12 times 1 is 12, and 9 I carry is 21, and the laſt 9 belonging to the 99 makes 30.

Now, the reaſon of this will appear plain, if you conſider that 17 *C.* is 1700 *lb.* and 17 times 12 *lb.* therefore I only ſet down 1700 *lb.* and add 12 times 17 to it.

Thus, 17 *C.* is ——— 1700
More, 12 times 17 is 204 add
———
Anſ. 1904 *lb.* in 17 *C.*

1700 — 99 *lb.*
So alſo 303 is 12 times 17, and 99.
———
2003 as before.

☞ *Note*, Or you may do it ſhorter yet, only by putting or joining the odd *lbs.* by the ſide of the *C*'s, making a dot between them for diſtinction ſake) then multiply the *C*'s only by 12, placing 2 figures out from them, as before directed, and you have the anſwer, which will ſave the trouble of taking in.

Thus, 17 - 99 I ſet down 17.99
204

Anſ. 2003 *lb.*

Here I multiply 17 only by 12, always placing the two firſt figures to the right-hand: then add the two lines together.

EXAMPLE 2.

In 47 *C.* 1 *qr.* 26 *lb.* neat, how many *lb.*

	C. *qr.* *lb.*	*C.* *lb.*	
Here	47 - 1 - 26 is	47.54	multiply 47 only by 12.
47 multiplied by 12 is		564	
		5318 *Anſ.*	

EXAMPLE 3.

In 86 *C.* 1 *qr.* 17 *lb.* *neat*, how many *lbs.*

	C. *qr.* *lb.*	*C.* *lb.*
Here	86 - 1 - 17 is	86.45
86 multiplied by 12 is		1032
		9677 *Anſ.*

Here I join the odd 45 *lb.* cloſe to the 86 *C.* and then multiply 86 only by 12, placing two figures out as before.

Tyro. Very well, ſir, I underſtand what you have ſhewn me; but ſuppoſe the odd pounds amount to three figures, may I join them to the *C*'s then?

Philo. No, only two of them; and place the other figures (which will always be 1) under the units place of the *C*'s, as in the following example.

Ex.

EXAMPLE 4.

Reduce 89 *C.* 3 *qrs.* 21 *lb. neat*, into *lbs.*
That is, 89 *C.* and 105 *lb.* Thus 89
3 *qrs.* 21 *lb.* is ——— 105 *lb.*
89 multiplied by 12 is ——— 1068
Anſ. 10073 *lb.*

Here 3 *qrs.* 21 *lbs.* make 105 *lbs.* and becauſe there are three figures, I place the 1 under the 9, and thus for all ſuch examples.

Now, *Tyro*, I will prove this laſt example by the other three methods, and leave you to take your choice as practice or fancy direct.

C. *qrs.* *lb.*
89 - 3 - 21
4
359
28
2873
720
10073 *lb.* common.

C. *lb.*
Secondly, 89 - 105
89
89
89
105
10073 *lb.*

C. *lb.*
Thirdly, 89 - 105*
112
10073 *lb.*

* This third method is certainly very ſhort, if once you can multiply well by 112: for obſerve, I ſay, 12 times 9 is 108, and 5 (the odd *lbs.*) is 113; 3, and I carry 11; then 12 times 8 is 96, and 11 is 107, and the 10 *lb.* is 117, that is, 7 and I carry 11; *laſtly*, I ſay, *once* 89 is 89, and 11 I carried is 100.

Tyro. Sir, I heartily thank you; I ſee now how it is done.

Philo. Then I will give you one example at large.

Ex-

EXAMPLE 5.

Bought 3 hogſheads of ſugar, as under.

		C.	qrs.	lb.
Groſs	No. 1	11	2	15
	2	15	1	17
	3	17	3	14
Groſs		44	3	18
Tare		1	1	2
Suttle		43	2	16

Tare of all 1 *C.* 1 *qr.* 2 *lbs.* *Tret* 4 *lb.* for every 104, at 56 ſhillings a *C. neat*, what come they to?

lb.
26)4888(188 *Tret*
26
228
208
208
208

Suttle 4888 *lbs.*
Tret 188 *lbs.*
Neat 4700 *lbs.*

Then, if 1 *C. viz.* 112 *lb.* coſt 2*l.* 16*s.* what coſt 4700 *lbs. neat?* *Anſ.* £.117 - 10*s.*

EXAMPLE 6.

Bought 3 cheſts of tea, each weighing, *groſs*, 1 *C.* 3 *qrs.* 12 *lb.* *tare* of each 1 *qr.* 5 *lb.* at 4*s.* 9*d.* a *lb. neat*, what do they come to?

Here being no *tret*, the *tare* taken out of the *groſs*, the remainder is *neat*. *Anſ.* £.124 - 13 - 9

Tyro. I am highly obliged to you, ſir; and am now ready for the next rule, if you pleaſe.

Philo. The next thing I ſhall inſtruct you in is the rule of *Practice.*

DIALOGUE IX.

SECTION I.

Of PRACTICE.

Tyro. WHAT do you mean by *Practice?*

Philo. Practice is only *Diviſion of Money*, and very much reſembles *Reduction aſcending*; for here you divide by as many of the *leſs* as make one of the *greater*. It is a ſhort contracted way of the *Rule of Three Direct*, and ſaves the trouble of ſtating queſtions, by dividing by the parts contained in the whole.

Tyro. Are not *Vulgar Fractions* often taught before *Practice?*

Philo. They are; but there is no neceſſity for it; if you can read a fraction, that is enough. Thus $\frac{2}{7}$, $\frac{3}{4}$, $\frac{1}{8}$, or $\frac{1}{12}$, are thus read, 2 *ſevenths*, 3 *fourths*, 1 *eighth*, and 1 *twelfth*.

Tyro. I know this very well, ſir.

Philo. Then you may proceed to work this rule as ſoon as you pleaſe; but it will be neceſſary to learn the following tables by heart.

TABLE

TABLE 1.

Even Parts of a Shilling.

Pence			
6		$\frac{1}{2}$	of a ſhilling
4		$\frac{1}{3}$	
3		$\frac{1}{4}$	
2		$\frac{1}{6}$	
1$\frac{1}{2}$ *qrs.*	is	$\frac{1}{8}$	
1		$\frac{1}{12}$	
$\frac{3}{4}$		$\frac{1}{16}$	
$\frac{2}{4}$		$\frac{1}{24}$	
$\frac{1}{4}$		$\frac{1}{48}$	

TABLE 2.

Even Parts of a £. Sterling.

Shillings			
10		$\frac{1}{2}$	of a £.
6-8*d.*		$\frac{1}{3}$	
5		$\frac{1}{4}$	
4		$\frac{1}{5}$	
3-4*d.*		$\frac{1}{6}$	
2-6*d.*	is	$\frac{1}{8}$	
2		$\frac{1}{10}$	
1-8*d.*		$\frac{1}{12}$	
1-3*d.*		$\frac{1}{16}$	
1		$\frac{1}{20}$	

Tyro. I will learn theſe tables as faſt as I conveniently can.

Philo. Very well; then I ſhall proceed to give you examples under the following *Caſes.*

CASE 1.

When the ſum is given in farthings, that is, 1, 2, or 3 farthings *per lb.* or *yard*, then only bring theſe farthings into *pence*, *ſhillings*, and *pounds*, and the work is done.

$\frac{1}{4}$	$\frac{1}{4}$	1753*lb.* at $\frac{1}{4}$ a *lb.*
1*d.*	$\frac{1}{12}$	438$\frac{1}{4}$
1*s.*	2|0	3|6-6*d.*
		1-16-6$\frac{1}{4}$ *Anſ.*

Here 1753 *lbs.* at a farthing a *lb.* is 1753 farthings, therefore I only divide by 4, by 12, and by 20, and have £. 1-16-6$\frac{1}{4}$ *Anſ.*

½ *ny*	½	1753 *lb.* at ½ *ny* a *lb.*
1*d.*	$\frac{1}{12}$	876-½
1*s.*	2|0	7|3
		£.3-13-0½ *Anſ.*

Here 1753 is 1753 halfpence. I divide therefore by 2, to bring them into pence, and by 12 and 20, to bring them into £'s, and the anſwer is £.3-13-0½, which is juſt double the firſt ſum, at a farthing a *lb.* and is a proof to it.

* ¾	⅛	1753 *lb.* at ¾ *per lb.*
6*d.*	½	219-¾
1*s.*	2|0	10|9-6
		£.5-9-6¾ *Anſ.*

Here I ſay, 3 farthings is the 1-8th of ſix-pence, and dividing by 8, I have 219 ſix-pences, and 3 farthings over; then I divide by 2 (becauſe 6*d.* is ½ of a ſhilling) and have 109 ſhillings, and 6*d.* over; then I divide by 20, to bring them into £'s, and have £.5-9-6¾.

Note, If you add the anſwers of the *firſt* and *ſecond* ſum together, you will find they amount to £.5-9-6¾, which proves the work.

* There is another way to do this: Multiply 1753 by 3 farthings, and the product is farthings; then divide by 4, 12, and 20.

		1753 *lb.* at ¾ *per lb.*
		3
	4	5259
	12	1314-¾
	2|0	10|9-6
		£.5-9-6¾ *Anſ.*
d.		*Yards*
1	1/12	1753 * at 1*d. per yd.*
	2|0	14|6-1
		£.7-6-1 *Anſ.*

* *Note*, I make uſe of the ſame number, 1753, becauſe you may prove the work of one ſum by another, by adding the product of any two together, thus: the product of 3 farthings and 1 farthing will prove the laſt ſum of a penny.

CASE 2.

When the given price is pence and farthings, then take the parts for the pence firſt, and then the parts for the farthings.

d.		*Ells*
1	1/12	1753 at 1¼*d. per ell*
¼	¼	146-1*d.*
		36-6¼ *
	2|0	182 -7¼
		£.9-2-7¼ *Anſ.*

* Here I ſay, 1 penny is the 1/12 of a ſhilling; then I ſay, 1 farthing is the ¼ of a penny, and dividing 146 ſhillings by 4, I have 36 ſhillings, and 2 remains, which is two ſhillings; then I ſay, the 4th of 2 ſhillings is 6*d.* and the 4th of a penny is ¼; then I add them both together, which make 182*s.* 7*d.* ¼, and dividing by 20, I have £.9-2-7¼ for *anſwer.*

☞ Always remember that what remains is ſhillings and pence, and you muſt alſo divide ſuch ſhillings by the ſame figure, and you have the true anſwer.

d.		*lb.*
1½	⅛	1753 at 1½*d. per lb.*
	2|0	21|9-1½
		£.10-19-1½ * *Anſ.*

* This you ſee is juſt double the ſum of three farthings.

d.		*lb.*
1½	⅛	1753 at 1¾*d.*
¼	⅙	219-1½ 36-6¼*
	2|0	25|5-7¾
		£.12-15-7¾

* *Note,* Here I ſay, 3 half-pence is the ⅛th (as before) then I ſay, 1 farthing is the ⅙th of 3 half-pence, and dividing by 6, I have 36, and 3 remains, which 3 I call 3 ſhillings; then I ſay, the 6th part of 3 ſhillings is 6 pence, and the 6th part of 1½ is ¼. Thus you ſee I take the parts of the remainder as well as the parts of the whole.

Pray, obſerve, *Tyro*, and look well at the example; for I ſhall now leave you to yourſelf for a while.

		Yards
2*d*	⅙	1753 at 2*d. per yard*
	2|0	29|2-2*d.*
		£14-12-2 *Anſ.*

2*d*	⅙	1753 *lb.* at 2¼*d.*
¼	⅛	292-2*d.* 36-6¼
	2|0	32|8-8¼
		£16-8-8¼ *Anſ.*

2*d*	⅙	1753 *oz.* at 2½*d.*
½	¼	292-2*d.* 73-0½
	2|0	36|5-2½
		£18-5-2½

2*d*	⅙	1753 *Ells* at 2¾*d.*
½ ¼	¼ ½	292-2*d.* 73-0½ 36-6¼
	2|0	40|1-8¾
		£20-1-8¾ *Anſ.*

3*d*¼

		lb.
3*d*	¼	1753 at 3*d.*
	2|0	43|8-3
		£21-18-3 *Anſ.*

		lb.
3*d*	¼	1753 at 3¼*d.*
¼	$\frac{1}{12}$	438-3 36-6¼
	2|0	47|4-9¼
		£23-14-9¼ *Anſ*

		lb.
3*d*	¼	1753 at 3½*d.*
½	⅙	438-3*d.* 73-0½
	2|0	51|1-3½
		£25-11-3½ *Anſ.*

		lb.
3*d*	¼	1753 at 3¾*d.*
¾	¼	438-3*d.* 109-6¾
	2|0	54|7-9¾
		£27-7-9¾ *Anſ.*

		Dozen
4*d*	⅓	1753 at 4*d.*
	2|0	58|4-4
		£29-4-4 *Anſ.*

		lb.
3*d*	¼	1753 at 4¼*d.*
1*d* ¼	⅓ ¼	438-3 146-1 36-6¼
	2|0	62|0-10¼
		£31-0-10¼ *Anſ.*

		lb.
4*d*	⅓	1753 at 4½*d.*
½	⅛	584-4 73-0½
	2|0	65|7-4½
		£32-17-4½ *Anſ.*

		lb.
4*d*	⅓	1753 at 4¾*d.*
½ ¼	⅛ ½	584-4*d.* 73-0½ 36-6¼
	2|0	69|3-10¾
		£34-13-10¾ *Anſ.*

		lb.
4*d*	⅓	1753 at 5*d.*
1*d*	¼	584-4 146-1
	2|0	73|0-5
		£36-10-5 *Anſ.*

		Ells
4*d*	⅓	1753 at 5¼*d.*
1*d*	¼	584-4
¼	¼	146-1
		36-6¼
	20	76|6-11¼
		£38-6-11¼ *Anſ.*

		lb.
4*d*	⅓	1753 at 5½*d.*
1*d*	¼	584-4
½	½	146-1
		73-0½
	2|0	80|3-5½
		£40-3-5½ *Anſ.* *

* Or you may take the parts thus, *viz.* 4*d.* is ⅓ of a ſhilling, as before. Or thus,

		lb.
4*d*	⅓	1753 at 5½*d.*
1½	†⅛	584-4*d.*
		219-1½
	2|0	80|3-5½
		£40-3-5½ *Anſ.*

† Here I ſay, 1½ is ⅛ of a ſhilling, and take it out of 1753, the top line, which anſwers the ſame end as the laſt work.

4*d*	⅓	1753 *lb.* at 5¾*d.*
1½	⅛	584-4*d.*
¼	⅙	219-1½
		36-6¼
	2|0	83|9-11¾
		£41-19-11¾ *Anſ.*

		lb.
6*d*	½	1753 at 6*d.*
	2|0	87|6-6
		£43-16-6 *Anſ.*

		Yards
3*d*	¼	1753 at 6¼*d.*
d.		
3*	¼	438-3
¼	1/12	438-3
		36-6¼
	2|0	91|3-0¼
		£45-13-0¼ *Anſ.*

* Here I ſay, 3 pence is the ¼th of a ſhilling in the ſecond line as well as in the firſt, becauſe then ¼ will be the 1/12; whereas, if I was to ſay 6*d.* is the ½ of a ſhilling, then I muſt ſay ¼ is the 1/24 of 6 pence; now 24 is not ſo eaſy to divide by as 12 is; ſo by bringing ſixpence into 2 parts,

the work is a great deal more eaſy and natural.

Buſhels

6*d*	½	1753 at 6½*d*.
½	$\frac{1}{12}$	876-6
		73-0½
	2|0	94|9-6½
		£47-9-6½ *Anſ.*

oz.

6*d*	½	1753 at 6¾*d*.
¾	⅛	876-6
		109-6¾
	2|0	98|6-0¾
		£49-6-0¾ *Anſ.*

6*d*	½	1753 *lb.* at 7*d*.
1*d*	⅙	876-6*d*.
		146-1*d*.
	2|0	102|2-7
		£51-2-7 *Anſ.*

6*d*	½	1753 *gall.* at 7¼*d*.
1*d*	⅙	876-6*d*.
¼	¼	146-1
		36-6¼
	2|0	105|9-1¼
		£52-19-1¼ *Anſ.*

lb.

6*d*	½	1753 at 7½*d*.
1½	¼	876-6
		219-1½
	2|0	109|5-7½
		£54-15-7½ *Anſ.*

Ells

4*d*	⅓	1753 at 7¾*d*.
3*d*	¼	584-4
¾	¼	438-3
		109-6¾
	2|0	113|2-1¾
		£56-12-1¾ *Anſ.*

Or you may ſay, 6*d*. is ½, and 1*d*. is ⅙, and ¾ is the ⅛ of 6*d*.

Yards

4*d*	⅓	1753 at 8*d*.
4*d*	⅓	584-4
		584-4
	2|0	116|8-8
		£58-8-8 *Anſ.*

Or you may ſay, 3*d*. is ½, and 2*d*. is ⅓ of 6 pence; or as 8*d*. is ⅔ of a ſhilling, you may multiply by 3, and divide by 2.

		lb.
6*d*	½	1753 at 8¼*d.*
2*d*	⅓	876-6
¼	⅛	292-2
		36-6¼
	2|0	120|5-2¼
		£60-5-2¼ *Anſ.*

		Pair
4*d*	⅓	1753 at 8½*d.*
4*d*	⅓	584-4
½	⅛	584-4
		73-0½
	2|0	124|1-8½
		£62-1-8½ *Anſ.*

		Ells
4*d*	⅓	1753 at 8¾*d.*
4*d*	⅓	584-4
½	⅛	584-4
¼	½	73-0½
		36-6¼
	2|0	127|8-2¾
		£63-18-2¾ *Anſ.*

6*d*	½	1753 *lb.* at 9*d.*
3*d*	½	876-6
		438-3
	2|0	131|4-9
		£65-14-9 *Anſ.*

		Yards
6*d*	½	1753 at 9¼*d.*
3*d*	½	876-6
¼	$\frac{1}{12}$	438-3
		36-6¼
	2|0	135|1-3¼
		£67-11-3¼ *Anſ.*

		Ells
6*d*	½	1753 at 9½*d.*
3*d*	½	876-6
½	⅙	438-3
		73-0½
	2|0	138|7-9½
		£69-7-9½ *Anſ.*

		lb.
6*d*	½	1753 at 9¾*d.*
3*d*	½	876-6
¾	¼	438-3
		109-6¾
	2|0	142|4-3¾
		£71-4-3¾ *Anſ.*

		Ells
6*d*	½	1753 at 10*d.*
4*d*	⅓	876-6
		584-4
	2|0	146|0-10
		£73-0-10 *Anſ.*

		oz.
6*d*	½	1753 at 10¼*d.*
3*d*	½	876-6
1*d*	⅓	438-3
¼	¼	146-1
		36-6¼
	2|0	149|7-4¼
		£74-17-4¼ *Anſ.*

6*d*	½	1753 *lb.* at 10½*d.*
3*d*	½	876-6
1½	½	438-3
		219-1½
	2|0	153|3-10½
		£76-13-10½ *Anſ.*

6*d*	½	1753 *oz.* at 10¾*d.*
3*d*	½	876-6
1½	½	438-3
¼	⅙	219-1½
		36-6¼
	2|0	157|0-4¾
		£78-10-4¾ *Anſ.*

6*d*	½	1753 *oz.* at 11*d.*
4*d*	⅓	876-6
1*d*	¼	584-4
		146-1
	2|0	160|6-11
		£80-6-11 *Anſ.*

		Ells
6*d*	½	1753 at 11¼*d.*
4*d*	⅓	876-6
1*d*	¼	584-4
¼	¼	146-1
		36-6¼
	2|0	164|3-5¼
		£82-3-5¼ *Anſ.*

		lb.
6*d*	½	1753 at 11½*d.*
4*d*	⅓	876-6
1½	¼	584-4
		219-1½
	2|0	167|9-11½
		£83-19-11½ *Anſ.*

		lb.
6*d*	½	1753 at 11¾*d.*
4*d*	⅓	876-6
1½	¼	584-4
¼	⅙	219-1½
		36-6¼
	2|0	171|6-5¾
		£85-16-5¾ *Anſ.*

		lb.
1*s*	2|0	175|3 at 12*d.*
		£87-13 *Anſ.*

And thus, *Tyro*, I have ſhewn you, from one farthing to a ſhilling, how to take the parts, ſo as to do any ſum for any number of *lbs.* yards, &c. You may by your own practice take the parts in what manner you pleaſe, only remember this *ſtanding rule*, That when you take the parts of a ſhilling, you muſt divide the top number by ſuch parts; but when you take the parts of any part, you muſt divide ſuch a part by the number of parts, and not the top line. Do you underſtand it?

Tyro. I do, ſir, very well; but pray, ſuppoſe the price exceeds one ſhilling, how muſt I do then?

Philo. That you will ſoon learn by the following CASE.

CASE 3.

When the given price exceeds one ſhilling, or 12 pence, but is leſs than two ſhillings, then let the top line, or given number, ſtand as it is given, without drawing any line under it, for that is the price or value at 1 ſhilling; then take the parts as before out of the top line, or given number, and add the ſaid parts and top number together, you have the anſwer in ſhillings, pence, and farthings, which divide by 20, as before.

EXAMPLES *above twelve Pence, and under two Shillings.*

3*d*	¼	1753 *lb.* at 15*d.*
		438 - 3*d.*
	2|0	219|1 - 3*d.*
		£109-11-3 *Anſ.*

Here you ſee that I let 1753 ſtand without drawing a line, and that is of itſelf an anſwer for 12*d.* a *lb.* Then I ſay, as before; 3*d* is ¼, and adding theſe two together, muſt be the price at 15*d.* for 12 and 3 is 15.

6*d*	½	1753 *ells* at 19½*d.*
1½	¼	876 - 6*d.*
		219 - 1½
	2|0	284|8-7½
		£142-8-7½ *Anſ.*

EXAMPLES *of other Numbers.*

6*d*	$\frac{1}{2}$	47 *yards*, at 21 $\frac{1}{2}$*d.*
3*d*	$\frac{1}{2}$	23 - 6*d.*
$\frac{1}{2}$	$\frac{1}{6}$	11 - 9
		1 - 11$\frac{1}{2}$
	2|0	8|4 - 2$\frac{1}{2}$
		£4-4-2$\frac{1}{2}$ *Anſ.*

6*d*	$\frac{1}{2}$	* 85 *ells*, at 22$\frac{1}{2}$*d.*
3*d*	$\frac{1}{2}$	42 - 6
1$\frac{1}{2}$	$\frac{1}{2}$	21 - 3
		10 - 7$\frac{1}{2}$
	2|0	15|9 - 4$\frac{1}{2}$
		£7-19-4$\frac{1}{2}$ *Anſ.*

* There is a ſort of *mechanical* method of doing ſums, or caſting up the total of the price of any commodity, which is often uſed in buſineſs by ſuch as are not acquainted with taking the parts according to the ſtrict order of this rule.

A mechanical or cuſtomary Way of caſting up any of the foregoing Examples for thoſe that cannot divide by the Parts.

Let us take the laſt *example*, *viz.* 85 *ells*, at 22$\frac{1}{2}$*d. per* ell.

Rule. Count how many ſhillings, ſix-pences, groats, pence, or any other denomination the given number makes, and ſet the products under one another, as in *Addition*; then add all together, and you have the anſwer.

Thus, the laſt *example*, 85 *ells* at 22$\frac{1}{2}$*d. per* ell.

Firſt,	85 ſhillings	£.4 - 5 -
	85 ſix-pences	2 - 2 - 6
	85 Three-pences is	1 - 1 - 3
	85 pence	- 7 - 1
	85 half-pence	- 3 - 6$\frac{1}{2}$
		£.7 - 19 - 4$\frac{1}{4}$ as before.

Tyro. I heartily thank you, ſir, for theſe obſervations.

Philo. I do it to ſerve you, take which way you pleaſe; for that is the beſt which is ſooneſt underſtood, though it be a little deviating from the ſtated rule itſelf. And now, *Tyro*, we will proceed to the other part of this rule.

CASE 4.

Rule 1. When the given price is above two ſhillings, then (by *table* 2) take ſuch ſhillings as are even parts of a £. and divide the given quantity thereby; then take the pence as are parts of a ſhilling, and the farthings as are parts of a penny, and divide each ſum or line by the parts to which they belong. Or,

Rule 2. Multiply the given quantity by the ſhillings, then take the parts for the pence and farthings, as in the laſt caſes, and add all together; then divide by 20, and it is done.

A few EXAMPLES, *with Words at length.*

		Yards
2*s*	⅒	125 at 2*s*. 8½*d*. *yd*.
6*d*	¼	12 - 10*s*.
2*d*	⅓	3 - 2 - 6*d*.
½	¼	1 - 0 - 10
		- 5 - 2½
		£.16 - 18 - 6½ *Anſ*.

Here 2*s*. is the ⅒ of a £. therefore I divide 125 by 10, and it gives £.12-10*s*. the price at 2*s*. *per* yard. Then 6*d*. is the ¼ of 2*s*. I therefore divide £ 12-10*s*. by 4, and it gives £. 3-2-6. Then 2*d*. is ⅓ of 6*d*. I therefore divide £. 3-2-6 by 3, and it gives £. 1 and 10 pence, the price at 2*d*. *per* yard. *Laſtly*, I ſay, 1 halfpenny is ¼ of 2*d*. and take the ¼ of £. 1-10*d*. which is 5*s*. 2½*d*. the price at a halfpenny a yard. The ſum of all theſe is £. 16-18-6½ *Anſ*.

PROOF.

PROOF *by the ſecond* RULE.

d.		*Yards*
6*	½	125 at 2ſ. 8½*d.*
		2
		250
2*d*	⅓	62 - 6*d.*
½	¼	20 - 10
		5 - 2½
2|0		33|8 - 6½
		£16 - 18 - 6½ as before

* Here I multiply 125 by 2, and it gives 250 ſhillings, at 2ſ. a yard. Then I ſay, 6*d.* is ½ of a ſhilling, therefore I divide the top line 125 by 2, (and not 250) and it gives 62ſ. 6*d.* and ſo for any other ſum; then I take the other parts, as before directed, as by the work appears.

Philo. Do you underſtand it?

Tyro. I do very well; but I like the laſt way the beſt.

Philo. Take which you pleaſe; 'tis only uſe that makes both eaſy.

		Ells
5ſ	¼	417 at 5ſ. 10*d.*
d		
10	⅙	104 - 5ſ.
		17 - 7 - 6*d.*
		£121 - 12 - 6 *Anſ.*

Firſt, 5ſ. is ¼ of a £. I divide 417 by 4, gives £. 104 - 5ſ. then 10 pence is ⅙ of 5ſ. therefore I divide £. 104 - 5ſ. by 6, and find the quotient £. 17, and 2 over; this 2 I call 2 pounds, and the odd 5ſ. makes £. 2 - 5, or 45 ſhillings; then I ſay, the 6's in 45 is 7 times, and 3 over; this I call 3 ſhillings, and divide that alſo by 6, it gives 6 pence.

PROOF.

4*d*	$\frac{1}{3}$	417 *ells* at 5*s*. 10*d*.
		5
		2085
4*d*	$\frac{1}{3}$	139
2*d*	$\frac{1}{2}$	139
		69 - 6*d*.
	2|0	243|2-6
		£121-12-6 as before

Here I multiply by 5, and it makes ſhillings; then I ſay, 4 pence is $\frac{1}{3}$ of a ſhilling, and take it out of the top line 417: I ſay again, 4 pence is $\frac{1}{3}$, and ſet down the ſame; then 2 pence is $\frac{1}{2}$ of 4 pence, and having added all up, and divided by 20, I have the ſame anſwer.

Two more EXAMPLES.

10*s*	$\frac{1}{2}$	57 pieces at 12*s* 9½*d*
s.*d*.		
2-6	$\frac{1}{4}$	28 - 10
3*d*	$\frac{1}{10}$	7 - 2 - 6
½	$\frac{1}{6}$	- 14 - 3
		- 2 - 4½
		£36 - 9 - 1½ *Anſ*.

PROOF.

6*d*	$\frac{1}{2}$	57 pieces at 12*s* 9½*d*
		12
		684
3*d*	$\frac{1}{2}$	28 - 6
½	$\frac{1}{6}$	14 - 3
		2 - 4½
	2|0	72|9 - 1½
		£36-9-1½ as before

10*s*	$\frac{1}{2}$	185 load at 18*s*. 10*d*.
4*s*	$\frac{1}{5}$	92 - 10
4*s*	$\frac{1}{5}$	37
8*d*	$\frac{1}{6}$	37
2*d*	$\frac{1}{4}$	6 - 3 - 4*d*.
		1 - 10 - 10
		£174 - 4 - 2 *Anſ*.

PROOF.

6*d*	$\frac{1}{2}$	185 load at 18*s* 10*d*
		18 multiply
		3330
4*d*	$\frac{1}{3}$	92 - 6
		61 - 8
	2|0	348|4 - 2
		£174-4-2 as above

And thus, *Tyro*, you may take which method you pleaſe; but in the next *caſe* you are confined to take the parts according to *table* 2.

CASE 5.

When the given price of any thing is more than 20 ſhillings, or one pound, and not ſo much as 2 pounds, then let the given quantity ſtand without drawing a line under it, and that is the price at 1 pound; then take the parts for the ſhillings and pence, as in the laſt *caſe*, and the work is done.

EXAMPLES.

		Ells
10*s*.	½	45 at £ 1 - 12 - 6
2*s*.6*d*	¼	22 - 10
		5 - 12 - 6
		£. 73 - 2 - 6 *Anſ*.

Here I let 45 ſtand without drawing any line under it, which is the price at 1 pound *per* ell; then I take the parts according to the rule in the laſt *caſe*, and adding all together, have £. 73 - 2 - 6 *Anſ*.

		Tons
10*s*.	½	75 at £. 1-17-11½
5	½	37 - 10
2*s* 6*d*	½	18 - 15
5*d*	⅙	9 - 7 - 6
½	⅒	1 - 11 - 3
		- 3 - 1½
		£. 142 - 6 - 10½ *Anſ*.

Here you ſee 75 tons at £. 1 *per* ton is £. 75, which I let ſtand without drawing any line under it, and then I take the parts for 17*s*. 11½*d*. as you find in the margin.

CASE 6.

When the given price of the commodity is above two pounds, then multiplying by the pounds gives the anſwer, for the number of pounds; and the ſhillings, pence, and farthings muſt be taken out of the top, or given number, as before directed.

EXAMPLE.

10*s*	$\frac{1}{2}$	37 *loads* at £.3-16-9
		3
		111
5*s*	$\frac{1}{2}$	18 - 10
1*s*	$\frac{1}{5}$	9 - 5
6*d*	$\frac{1}{2}$	1 - 17
3*d*	$\frac{1}{2}$	18 - 6
		9 - 3
		£141 - 19 - 9 *Anſ.*

Here I multiply 37 by £. 3, which gives £.111; and then I ſay, 10*s.* is $\frac{1}{2}$ of a £. and take it out of the top £. 37, which is £. 18 - 10*s.* then I ſay, 5 ſhillings is $\frac{1}{2}$ of 10, and take the $\frac{1}{2}$ of £.18 - 10*s.* which is £. 9 - 5*s.* and ſo I go on taking the parts, as the work plainly ſhews.

One EXAMPLE *at large.*

		Hhds.
10*s*	$\frac{1}{2}$	15 at £. 12-18-0$\frac{3}{4}$
		12
		180
5*s*	$\frac{1}{2}$	7 - 10
2-6	$\frac{1}{2}$	3 - 15
6*d*	$\frac{1}{5}$	1 - 17 - 6
$\frac{3}{4}$	$\frac{1}{8}$	7 - 6
		11$\frac{1}{4}$
		£.193 - 10 - 11$\frac{1}{4}$ *Anſ.*

Here 15 hhds, at £. 12 *per* hhd. is 180 £; then I ſay, 10*s.* is $\frac{1}{2}$, and take the $\frac{1}{2}$ of £. 15, the top number, which is £. 7 - 10*s.* and ſo proceed, by taking the reſt of the parts, ſaying, 5 ſhillings is the $\frac{1}{2}$ of 10 ſhillings, and take the $\frac{1}{2}$ of £. 7 - 10*s.* &*c.*

And now, *Tyro*, I think you have had ſufficient inſtructions in this rule, if you carefully obſerve them. However, that I may omit nothing that may be uſeful to you in buſineſs, there are ſome ſhorter methods of caſting up things than the rule itſelf teaches; but this is according to the given price, that is, when the given price is juſt two ſhillings, or when it is any even number of ſhillings, as in the two following *caſes*.

CASE 7.

When the given price is any even number of ſhillings, as 2, 4, 8, 14, 16, &*c.* then multiply the given quantity by half the even number of ſhillings, and cut off the firſt figure in the units place with a daſh of your pen, or pencil: then all the figures to the left hand are pounds, and the figure you cut off in the units place being doubled, will be ſhillings, and you have the anſwer required.

EXAMPLES.

48 yards, at 4*s*. *per* yard.
2
——
£.9|6
Anſ. £.9-12*s*.

Here the price is 4 ſhillings *per* yard, therefore I multiply the given quantity 48 by half the price, (*viz.* 2) and it is 96; then I cut off the firſt figure, (*viz.* 6) and double it, which is 12 for the ſhillings, and the figure 9 is the pounds; ſo is the anſwer £. 9 - 12*s*. Again,

328 ells, at 12*s*. *per* ell.
6
——
£.196|8
Anſ. £.196-16*s*.

Here I multiply by 6, which is ½ the given price, and cut off the firſt figure, and double it for the ſhillings, which is 16, and the figures on the left hand of the daſh are pounds.

More EXAMPLES.

417 yards at 14*s*.
7
——
£.291|9 *Anſ.* £.291 - 18*s*.

Again, 695 ells at 18*s*.
9
——
£.625|5 *Anſ.* £.625-10

CASE 8.

When the given price is any even number of ſhillings, and you would know what quantity of any thing may be bought for any even number of pounds ſterling, then only add a cypher to the given pounds, and divide that ſum by half the number of the given price, gives the anſwer in pounds ſterling.

EXAMPLES.

How many *lb.* of tea, at 12*s.* *per lb.* may I have for £. 36? *Anſ.* 60 *lb.*

To £. 36 add a cypher, and it makes 360

$\frac{1}{2}$ of 12*s.* is 6)60 *lb.* *Anſ.*

How many gallons of rum, at 8*s.* *per* gallon, may I have for £. 250?

To £. 250 add a cypher, and it makes 2500

$\frac{1}{2}$ of 8*s.* is 4)625 gall. *Anſ.*

Tyro. I like this very well, ſir; and it is not only eaſier, but much ſhorter than taking the parts; but ſuppoſe there be fractions after the given number, how then?

Philo. Take ſuch *fractional* parts out of the given price, and add it to the reſt of the work, as by the following *caſe*.

CASE 9.

When the given quantity or number has *fractional* parts after it, then take ſuch parts out of the given price, and place the ſum under the reſt, and add all together. Or thus, (which may be eaſier) multiply the price by the *numerator*, (or top figure of the fraction) and divide the product by the denominator, (or lower figure) and you have the *fractional* value at once.

10*s.* | $\frac{1}{2}$ | 15$\frac{5}{8}$ yards at 10*s.*

$\frac{5}{8}$ | 7 - 10
6-3 for $\frac{5}{8}$ths

£.7 - 16 - 3 *Anſ.*

Here I ſay, $\frac{1}{8}$ of 10*s.* is 1*s.* 3*d.* therefore $\frac{5}{8}$ is 5 times as much, *viz.* 6*s.* 3*d.* Or thus, I multiply 10*s.* the price, by 5, the numerator, which is 50, and dividing by 8, the denominator, I have 6*s.* 3*d.* the price at $\frac{5}{8}$ths.

	$3\frac{7}{8}$ yards at 18*s.*	
	9*	
$\frac{7}{8}$	2 - 14	
	15 - 9	
	£. 3 - 9 - 9	*Anſ.*

* Here the price being an even number of ſhillings, I multiply by $\frac{1}{2}$ of it, *viz.* 9, (according to *caſe* 7) and double the firſt figure, which is £ 2-14*s.* Then for $\frac{7}{8}$ I multiply the price, *viz.* 18*s.* by 7, and divide by 8, and it is 15*s.* 9*d.* And thus may many ſums in this *caſe*, as well as in others, be done in a very ſhort and eaſy manner, by care and obſervation.

Tyro. I ſee it plainly, ſir; and now, if you pleaſe, I would be glad to have a notion of working *weight*, *viz.* *tons, cwts. qrs. lbs.* &c.

Philo. I am as ready to inſtruct you.

SECTION II.

Of WEIGHT.

Tyro. WHAT is the nature of working this rule?

Philo. By taking the parts, as before directed: as you will plainly ſee by and by; but firſt of all the two following tables ought to be learned perfectly.

TABLE 1.

Even Parts of a Ton.

C.	*qrs.*		
10	0	is	$\frac{1}{2}$ a *ton*
5	0		$\frac{1}{4}$
4	0		$\frac{1}{5}$
2	2		$\frac{1}{8}$
2	0		$\frac{1}{10}$
1	1		$\frac{1}{16}$
1	0		$\frac{1}{20}$

TABLE 2.

Even Parts of a Cwt.

qrs.	*lb.*		
2	0	is	$\frac{1}{2}$ an *Cwt.*
1	0		$\frac{1}{4}$
	16		$\frac{1}{7}$
	14		$\frac{1}{8}$
	8		$\frac{1}{14}$
	7		$\frac{1}{16}$

Having got the above *tables* pretty readily by heart, the rule is,

RULE.

RULE.

Multiply the given tons, or hundreds, by the given priee, and if there be any parts of ſhillings and pence, work with them as in the foregoing examples; this being done, take the parts for the odd weight out of the given price, and place it under the reſt, and the work is done.

But this is better underſtood by an example or two.

What comes 7 *C.* 3 *qrs.* to, at £. 2 - 6*s.* *per Cwt.*

		2
5*s.*	¼	14
1	⅕	1 - 15
2 *qrs.*	½	- 7
1	½	1 - 3
		- 11 - 6
		£.17 - 16 - 6 *Anſ.*

Here I multiply 7 by 2, and it gives £. 14; then I ſay, 5*s.* is ¼, and take ¼ of £. 7, the top number; then I ſay, 1*s.* is ⅕ of 5*s.* and take the ⅕ of £. 1-15*s.* This being done, I begin with the odd weight, ſaying, 2 *qrs.* is ½ of an *Cwt.* and I take the ½ of the price £. 2 - 6*s.* and it is £. 1 - 3*s.* then 1 *qr.* is ½ of 2 *qrs.* I take the ½ of £. 1 - 3*s.* which is 11*s.* 6*d.*

What coſt 14 *ton*, 6 *C.* 3 *qrs.* 14*lb.* at £.12-10*s.* *per ton?*

		12	
10*s.*	½	168	— The value at £.12 *per ton.*
5 *C.*	¼	7	— Ditto at 10*s.* *per ton.*
1 *C.*	⅕	3 - 2 - 6	— The ¼th of £. 12 - 10*s.*
2 *qrs.*	½	12 - 6	— The price of 1 *C.*
1 *qr.*	½	6 - 3	— Ditto of 2 *qrs.*
14 *lb.*	½	3 - 1½	— Ditto of 1 *qr.*
		1 - 6¾	— Ditto of 14 *lb.*
		£.179 - 5 - 11¼ *Anſ.*	

I have here, *Tyro*, ſet againſt every line what the value is, and where it is taken out of, that you may be the better grounded in the work: for remember, the money is taken out of the given weight, and the odd weight is taken out of the given price, as you were told in the rule.

Tyro. I ſee the nature of it, ſir, plainly.

Philo. Then I ſhall leave you a few queſtions for you to work, or prove at leiſure.

QUESTIONS *to exerciſe the Learner.*

1. What coſt 125 *lb.* of indigo, at 14¾*d.* *per lb?* *Anſ.* £. 7 - 13 - 7¾.

2. What is gained in £. 476, at 4*s.* 10½*d.* *per* £? *Anſ.* £. 116 and 6*d.*

3. What is the value of 47 load, at £3 - 15 - 6½ *per* load? *Anſ.* £. 177 - 10 - 5½

4. What coſt 9 *ton*, 15 *C.* 3 *qrs.* 27 *lb.* of iron, at £. 14 *per* ton? *Anſ.* £. 137 - 3 - 10½.

DIALOGUE X.

SECTION I.

SIMPLE INTEREST.

Tyro. SIR, you have given me great ſatisfaction in the rules of *Practice*, and now I ſhould be glad to be informed ſomething concerning *Intereſt.* Pray what is it?

Philo. *Intereſt* is money that ariſes from a certain ſum lent out at ſo much *per cent. per annum*; and is a conſideration allowed by the borrower to the lender.

Tyro. What do you mean by *per cent. per annum?*

Philo. *Per cent.* ſignifies by 100 pounds, and *per annum* ſignifies by the year, or 12 calendar months.

Tyro. How is the intereſt found?

Philo. *Intereſt* may be performed by the *Rule of Three Direct* (as you may ſee by *example* 1 following) but in ſome caſes it is done eaſier and ſhorter by *Practice* and cuſtom, and that is the reaſon that *Intereſt* has a place and title in all books of arithmetic by itſelf.

Tyro. Pleaſe to give an example by the *Rule of Three*, and prove it by the ſhort cuſtomary way.

Philo. I will.

EXAMPLE.

What is the intereſt of £. 175 - 10*s.* for a year, at £. 5 *per cent. per annum?*

```
     £.     £.               £.    s.
  If 100—be 5——what is 175 - 10
      20                      20
    ————                 ————
    2000                  3510
                                5
                         ————
                 2000)17550(8£.
                      16000
                      ————
                       1550
                         20
                      ————
                 2000)31000(15s.
                       2000
                      ————
                      11000
                      10000
                      ————
                       1000
                         12
                      ————
                 2000)12000(6d.
                      12000
                      ————
                          0
```

Anſ. £. 8 - 15 - 6

Here you ſee I am obliged to make my *firſt* and *ſecond* numbers of one name, ſo that according as the ſum is, it requires a great many figures; but by the other method you ſpare all this trouble; which pray obſerve.

Second METHOD. CASE I.

Multiply the principal, or given ſum, by the rate *per cent.* and cut off two figures towards the right hand, (which is the ſame, obſerve, as dividing by 100) and the figures towards the left are pounds intereſt: this done, multiply the figures cut off to the right hand by 20, take in the odd ſhillings, and cut off two figures, as before, and the figures on the left hand are ſhillings: then multiply the remainder by 12, and cut off two figures, and the figures on the left hand are pence. *Laſtly*, multiply by 4, and cutting off as before, you have the farthings.

Thus the above example is done, as under.

£. s.
175 - 10
5

£. 8)77 - 10
20

s. 15)50
12

d. 6)00
Anſ. £. 8 - 15 - 6 as above.

Tyro. Indeed this is very ſhort to what the firſt work is.

Philo. Then pray obſerve the rule; for all the following examples are performed after the ſame manner; and remember, that cutting off two figures towards the right hand is the ſame as dividing by 100.

Queſt. 2. What is the intereſt of £. 515 - 10*s.* for 1 year, at £. 4 *per cent. per annum?*

£. 515 - 10
4 *per cent.* multiply

£. 20)62
20

s. 12)40
12

d. 4)80
4

qrs. 3)20

Anſ. £. 20 - 12 - $4\frac{3}{4}\ \frac{20}{100}$, or $\frac{2}{10}$ths of a farthing.

Queſt. 3. What is the intereſt of £. 1050 for 1 year, at £. 3 *per cent. per annum?*

£. 1050
3 *per cent.*

£. 31)50
20

s. 10)00 *Anſ.* £. 31 - 10*s.*

Tyro. You need not give me any more examples of this ſort; but ſuppoſe the money be lent for more than one year, how then?

CASE 2.

Philo. When the given rate *per cent.* is an even part of £. 100, then divide the principal by that even part, and the quotient is the anſwer at once.

Take *example* 1, *viz.* £. 175 - 10*s.* at £. 5 *per cent.*

Here £. 5 being $\frac{1}{20}$ of £. 100, I only divide £. 175 - 10*s.* by 20, and it is done.

£. *s.*
2|0)17|5 - 10 *

£. 8 - 15 - 6 *Anſ.*

* *Note*, After I divide 175 by 20, I ſay, the 20th part of 10*s.* is 6*d.*

Queſt. 4. What is the intereſt of £. 345 - 17 - 6, at £. 25 *per cent.*

Here £. 25 being $\frac{1}{4}$ of £. 100, I divide the principal £. 345 - 17 - 6 by £. 4, and it is done.

£. s. d.
4)345 - 17 - 6
£. 86 - 9 - $4\frac{1}{2}$ *Anſ.*

CASE 3.

When the principal is put out for years and months, find the intereſt for the years firſt, and take the months as even parts of a year, according to the rules of *Practice.*

Queſt. 5. What is the intereſt of £. 175 - 10*s*. for 3 years, 9 months, at £. 5 *per cent. per annum?*

£. 175 - 10
5 *per cent.*
£. 8)77 - 10
20
s. 15)50
12
d. 6)00

	£.	s.	d.	
Intereſt for 1 year is	8	15	6	
			3	
	26	6	6	for 3 years
6 mths. $\frac{1}{2}$ a year	4	7	9	
3 mths. $\frac{1}{2}$	2	3	$10\frac{1}{2}$	
Anſ.	32	18	$1\frac{1}{2}$	

A practical

A practical QUESTION.

Queſt. 6. A gentleman left his niece by will £. 558 - 15*s.* to be paid her when ſhe came to age, with intereſt at £. 4 *per cent.* Now ſhe came to age in 5 years, 9 months, and 3 weeks: what has ſhe got to receive in all, principal and intereſt?

£. 558 - 15*s.*
4 *per cent.*

£. 22)35
20

s. 7)00

Intereſt for 1 year £. 22 - 7*s.*
5 years

	111	15		
6 mths. ½ year	11	3	6*d.*	
3 months, ½	5	11	9	
2 weeks ⅙		18	7½	
1 week ½		9	3¾	
	£. 129	18	2¼	intereſt
	558	15		legacy

The legacy and intereſt is £. 688 - 13 - 2¼

Tyro. Sir, I thank you for theſe two uſeful examples: and now I would only aſk this one favour, and that is, how am I to tell the intereſt of any ſum for any time, at 3½, 4½, 4¾, or the like *per cent?*

Philo. it is ſomething more difficult than the other, but an example or two, with your due obſervation, will make it very eaſy.

CASE 4.

When the given rate *per cent.* is not even pounds, but is $2\frac{1}{2}$, $3\frac{3}{4}$, $4\frac{1}{2}$, or the like, then multiply the principal or given ſum, by the even pounds, and take the $\frac{1}{2}$, or $\frac{1}{4}$, or $\frac{3}{4}$ of the ſaid principal, or given ſum, and add to that product; then cut off two figures, and proceed in all reſpects as before.

Queſt. 7. What comes the intereſt of a bond of £. 685 to, at £. $4\frac{1}{2}$ (that is, £. 4 - 10*s.*) *per cent. per annum?*

```
              £. 685
                   4
              ---------
 10 | 1/2 |     2740
      |          342 - 10
              ---------
          £. 30)82 - 10
                   20
              ---------
           s. 16)50
                   12
              ---------
           d.  6)00
```

Here I multiply by 4; then for $\frac{1}{2}$ *per cent.* which is 10 ſhillings, I ſay, 10*s.* is $\frac{1}{2}$, as in *Practice*, and take $\frac{1}{2}$ of 685, and add to the other, it is £. 3082 - 10*s.* then I cut off two figures, thus, 30)82, and proceed as before, I find it £. 30 - 16 - 6.

Queſt. 8. Lent £. 500 upon a mortgage, to receive intereſt at 4¾ (*viz.* £. 4 - 15*s.*) *per cent.* till it was paid off: now the mortgage was paid off 3 years 8 months after: I demand the intereſt due to me

		£.
		500
		4
s.		
10	½	2000
5	½	250
		125
		£. 23)75
		20
		s. 15)00

Intereſt for 1 year is £. 23 - 15
multiply by 3

		£.	s.	d.	
6 months	½	71	5		for 3 years
2 months	⅓	11	17	6	6 months
		3	19	2	2 months
		£. 87	1	8	*Anſ.*

Tyro. I underſtand all theſe examples very well; but ſuppoſe the intereſt be for leſs than a year, how then am I to find it?

Philo. Very eaſily.

CASE 5.

When the intereſt of any ſum is to be found for leſs than a year, *viz.* for 1, 2, 3, 4, or 10 months, or for months and odd days, then firſt find the intereſt for 1 year, and take the parts of that year's intereſt according to the given time: thus, if it be 6 months intereſt, take the half of the year's intereſt; if 9 months, take ¾; if three months, take ¼; and for the odd weeks or days, take the parts of thoſe months.

Queſt. 9. What is the intereſt of £. 175 - 10s. for 8 months, at £. 5 *per cent. per annum?*

£. 175 - 10
5

£. 8)77 - 10
20

s. 15)50
12

d. 6)00

		£.	s.	d.	
Intereſt for 1 year is		8	15	6	
Then ſay, 6 mths.	$\frac{1}{2}$	4	7	9	for 6 months.
2 mths.	$\frac{1}{3}$	1	9	3	for 2 months.
		£. 5	17		*Anſ.*

Here you ſee I take the half of one year's intereſt, which is £. 4 - 7 - 9 for 6 months; then I ſay, 2 months is $\frac{1}{3}$ of 6 months, and take the $\frac{1}{3}$ of £. 4 - 7 - 9, and add both together, is £. 5 - 17 for 8 months.

Tyro. I am ſatisfied, ſir.

Philo. This is the beſt way for calculating intereſt in general, and will be near enough for common practice, ſhould there be weeks or days; for it is only taking the parts for ſuch weeks and days, as was ſaid before.

Tyro. But ſuppoſe the intereſt be put out for ſuch a number of days as cannot well be taken in their even parts, how then?

RULE 1.

Philo. Firſt find the intereſt for one year as before; then ſay, if 365 days give ſo much, what will ſo many days give? Thus, ſuppoſe the intereſt for one year be

£. 17

£. 17 - 10 - 10, and it was required to find the intereſt for 73 days, I ſay,

If 365 days give £. 17 - 10 - 10, what will 73 days give? *Anſ.* 3 - 10 - 2.

RULE 2.

Bring the principal, or money lent out, into pence, and multiply thoſe pence by the number of days the ſum is put out at, or continues out; then if the rate *per cent.* it be put out at be £. 5, divide by 7300; and if it be £. 6 *per cent.* divide by 6083, you have the anſwer in pence. There are many other ways to find the intereſt for days; but I would recommend the firſt rule of theſe two to the learner, as it ſerves for all rates *per cent.* and is moſt certain.

SECTION II.

Of ASSURANCE, BROKERAGE, *or* COMMISSION.

Tyro. WHAT is *Aſſurance*, *Brokerage*, or *Commiſſion?*

Philo. *Aſſurances*, or *Inſurances*, are of various ſorts. An *Aſſurance* is when any perſon agrees with another at a certain rate *per cent.* to inſure his life for ſuch a time, or his ſhip upon a voyage from the dangers of the ſeas, or his houſe or goods from fire. *Brokerage* is an allowance of ſo much *per cent.* given to *Brokers*, or perſons employed in buying and ſelling ſtocks, or tranſacting buſineſs between buyer and ſeller: and *Commiſſion* is alſo an allowance of ſo much *per cent.* for buying and ſelling any ſort of commodity, by the order of any other perſon, *&c.*

Tyro. Then I perceive theſe are all caſt up the ſame way as intereſt of money is.

Philo. They are ſo, only intereſt is ſo much *per cent. per annum*; but *brokerage* is caſt up only at ſo much *per cent.* ready money, without any regard to time. Of theſe in their order.

1. *Of* ASSURANCES.

Queſt. 1. What comes an aſſurance of £. 580 to, at £. 10¾ *per cent.*

£. 580
10

s.
10 | | 5800
5 | ½ | 290
145

£. 62)35
20

s. 7)00

Anſ. £. 62 - 7

Here I multiply by 10, then I take the parts out of the top, or £. 580, and add all together, and cut off two figures (which is dividing by £. 100, and proceed as in intereſt, by multiplying the remainder by 20, &c.

Queſt. 2. Shipped for *Jamaica* goods to the value of £. 1200, upon which I made an aſſurance, at £. $7\frac{5}{8}$ths *per cent.* what does it come to?

£.
1200
7

$\frac{4}{8}$ is ½ | 8400
$\frac{1}{8}$ ¼ | 600
150

£. 91)50
20

s. 10)00

Here I multiply by 7. Then I ſay for the fraction, 4 eighths is ½, that is, ½ of $\frac{8}{8}$ths, (for 8 eighths is equal

L

to 1 whole integer) and take the $\frac{1}{2}$ of the top number; then I ſay, $\frac{1}{8}$ is $\frac{1}{4}$ of $\frac{4}{8}$ths; then I add all together, and cut off two figures, as before, &c. and find the anſwer £. 91 - 10*s.*

2. *Of* BROKERAGE *and* COMMISSION.

Tyro. You need not give me any more examples; for I ſee the work is the ſame, though under different titles or names.

Philo. It is ſo; but ſtill when the *per cent.* is ſhillings, it may be a little difficult to you, therefore I will give you an example or two.

Queſt. 3. What is the commiſſion of a broker for buying or ſelling £. 520 ſtock, at half a crown *per cent.*

Rule. Multiply the money by the ſhillings, and take the parts for the pence, as in *Practice*, then add all together, and cut off two figures to the right hand, and thoſe towards the left are your anſwer in ſhillings.

```
          £. 520
               2
          ------
6d. | ½ |   1040
        |    260
          ------
        s. 13)00
```

Anſ. 13 ſhillings.

Queſt. 4. What is my commiſſion on £. 1500 at 7*s.* *per cent?*

```
 1500
    7
 ----
s. 105)00
```

Anſ. £. 5 - 5*s.*

Another way.

Cut off two figures of the given ſum, and multiply the remainder by 20, 12, and 4, and this gives the anſwer, at £. 1 *per cent.* Then take the parts of the ſum of £. 1 *per cent.* as in *Practice*, you have your anſwer.

Queſt. 5. What is my commiſſion on £. 1252 - 10*s.* at 7*s.* 6*d.* *per cent?*

£. 12)52 - 10*s.*
20
s. 10)50
12
d. 6)00

At £. 1 *per cent.* it is £. 12 - 10 - 6

Then,	5*s.*	$\frac{1}{4}$	3 - 2 - $7\frac{1}{2}$
	2 - 6	$\frac{1}{2}$	1 - 11 - $3\frac{3}{4}$

Anſ. £. 4 - 13 - $11\frac{1}{4}$

3. COMPOUND INTEREST.

Tyro. What is *Compound Intereſt?*

Philo. Compound Intereſt is called *Intereſt upon Intereſt*; that is, the intereſt of the principal, and the intereſt of the intereſt, added together, is the *Compound Intereſt.* But it being ſeldom uſed without it be in purchaſing of annuities, &c. and being very tedious to calculate, is done with more eaſe by *Decimal Fractions.*

Tyro. But I ſhould be glad if you would give me a little better notion of it.

Philo. Suppoſe I put out £. 100 for 3 years, at £. 5 *per cent. compound* intereſt, what does it come to?

Firſt, I find the ſimple intereſt for one year is £. 5; then the ſecond year I am to count what the intereſt of £. 105 is, and find it £. 5 - 5. This I add to the laſt principal £. 105, and it makes £. 110 - 5. Then I ſee what is the intereſt of £. 110 - 5*s.* and find it £. 5 - 10 - 3 for the third year. Then I add theſe different intereſts together, *viz.* £. 5, £. 5 - 5*s.* and £. 5 - 10 - 3, and it makes £. 15 - 15 - 3, the *compound intereſt* for three years on £. 100, at £. 5 *per cent.* And thus for any number of years, at any rate *per cent.*

SECTION III.

Of REBATE OR DISCOUNT.

Tyro. WHAT do you mean by *Rebate* or *Diſcount?*

Philo. Diſcount is when a ſum of money, which is to be paid at any time to come, is ſatisfied by paying of it down in preſent money, which preſent money being put out after the ſame rate *per cent.* and for the ſame time, will be increaſed to the debt or ſum that was firſt to be paid.

Tyro. Explain this a little fuller in other words.

Philo. Suppoſe a perſon owes me 100 guineas, *viz.* £. 105, to be paid in a year, or 12 months to come, how much preſent money will ſatisfy the debt? *Anſ.* £. 100 preſent money will ſatisfy a debt of £. 105 due 12 months hence; becauſe £. 100 put out to intereſt 12 months will be £. 5.

There are ſeveral methods of performing this rule of *Diſcount*; but as it is beſt done by *Decimal Fractions*, I ſhall only give this one general rule.

A general RULE.

1. Add the intereſt of £. 100 for the given time to £. 100, and make this your *firſt number*; then place £. 100 only for your *ſecond* number, and the given debt your *third* number, and the anſwer will be the preſent money that will ſatisfy the debt due twelve months to come; then take this preſent money from the debt,' and the remainder is the *rebate* for twelve months.

2. Having thus found the *rebate* for one year, if the time be more or leſs than 12 months, take the parts by the rule of *Practice* accordingly.

3. Thus it appears that the *firſt number* is always known according to the rate *per cent.* for one year, as by the following table:

For at £. 3 *per cent.* the *firſt* number will be 103, &c.

£. 3	*per cent.*	103
4	———	104
5	———	105
6	———	106
7	———	107
8	———	108

Theſe, obſerve, are *firſt* numbers, according to the *rebate per cent.* for one year; £. 100 is your *ſecond*, and the debt your *third*, and the anſwer is the preſent money to be paid down.

Queſt. 1. What preſent money will pay a draught or note of hand of £. 368 - 4*s.* due three months hence, allowing rebate at £. 5 *per cent. per annum*?

If 105——100——368 - 4. *Anſ.* 350 - 13 - 4, which taken out of the debt £. 368 - 4*s.* leaves £. 17 - 10 - 8, the diſcount for one year. See the work.

Rule. Bring the *firſt* and *third* number into ſhillings; then multiply the *third* by your *ſecond*, and divide by your *firſt*, and you have £. 350, and 14 remains, which alſo multiply by 20, and divide by your *firſt number*, you have 13 ſhillings, and 7 remains, which multiply by 12, and dividing by the ſame *firſt* number, you have 4*d.*

Note of hand		£. 368 - 4	
Preſent money		350 - 13 - 4	
Diſcount is		17 - 10 - 8	for one year
3 months	¼	4 - 7 - 8	*Anſ.* for 3 months.

Which taken out of £. 368 - 4*s*. remains £. 363 - 16 - 4 preſent money to be paid down.

Here you ſee for one year, the *diſcount* is £. 17 - 10 - 8, and as 3 months is ¼ of a year, I take the ¼th of that ſum, which is £. 4 - 7 - 8 *Anſ.*

Note, Had the note been drawn for 15 months, that is, 1 year and 3 months; then add £. 4 - 7 - 8, the *diſcount* of three months, to £. 17 - 10 - 8, which is £. 21 - 18 - 4, the *diſcount* of £. 368 - 4*s*. for fifteen months.

An EXAMPLE *for Practice.*

What preſent money will pay a debt of £. 500, due 3 years, 4 months hence, allowing *rebate* at £. 6 *per cent. per annum?* *Anſ.* £. 416 - 13 - 4. *Rebate* £. 83 - 6 - 8. For by the table, your *firſt* number will be £. [illegible] for one year, your *ſecond* £. 100, and the *third* the debt. And for proof, find the intereſt of £. 416 - 13 - 4 for three years and four months, at £. 6 *per cent.* and add to it £. 416 - 13 - 4, you will have £. 500, the debt itſelf.

And, by theſe examples, you may find the *diſcount* at any rate *per cent.* and for any time, by obſerving the foregoing directions.

Tyro. I ſee the nature of working this rule very plainly.

Philo. Then I will give you a notion of another uſeful rule, *viz.*

SECTION

SECTION IV.

EQUATION OF PAYMENTS.

Tyro. WHAT do you mean by *Equation of Payments?*

Philo. Equation of Payments is when a certain ſum of money becomes due at different times, or is to be paid at different payments, and it is agreed between the debtor and creditor to ſet or pitch upon a certain time for the payment of the whole, without any damage or loſs to either.

Tyro. This is very pretty, as well as uſeful: pray give me the rule for working queſtions of this ſort.

RULE.

Multiply the ſum of each particular payment by the time it is to be paid in: then add the ſeveral products together, and divide the ſum by the whole debt, and the quotient is the *equated*, or juſt time for the payment of the whole.

Queſt. 1. A merchant buys goods to the value of £. 140, £. 30 of which is to be paid in 1 month, £. 40 in 3 months, £. 20 in 4 months, and £. 50 in 6 months; but it is agreed upon an *equated* time to pay the whole at once; I demand the *equated*, or juſt time of payment?

I ſet down each payment and the time right againſt it, and multiply the money by the time, and ſet the product of each right againſt them, as follows:

£. 30 multiplied by 1 month is £. 30
40 — by 3 months is 120 add
20 — by 4 months is 80
50 — by 6 months is 300

Debt 140)530(3 months
420

110
30*

140)3300(23 days
280

500
420

80

Anſ. 3 months, 23 days.

* *Note*, I multiply by 30, the days in a calendar month, according to the cuſtom of buſineſs, becauſe 12 ſuch months are reckoned to the year.

Queſt. 2. A merchant bought goods to the value of £. 500, upon the following conditions, *viz.* ¼th to be paid in 2 months, and the remainder in 6 months: I demand the equated time to pay the whole at one payment?

Firſt, ¼ of £. 500 is £. 125 multiplied by 2 mths £. 250
The remainder is 375 multiplied by 6 mths 2250

Debt £. 500 5|00)25|00

Anſ. 5 mths

Now £. 2500 divided by the debt £. 500 is 5 months for the anſwer, and thus for any other queſtion. Do you underſtand it?

Tyro. There can be nothing eaſier to apprehend than this.

QUESTIONS

QUESTIONS *to exerciſe this* RULE.

3. A father left his ſon £. 600, to be paid by his executor, as follows: $\frac{1}{3}$ in 2 months, $\frac{1}{3}$ in 3 months, and $\frac{1}{3}$ in 8 months; but he being very troubleſome to the executor, and he as willing to be rid of him, they agreed upon a time for the payment of the whole at once. The *equated* time is demanded. *Anſ.* 4$\frac{1}{3}$ months, *viz.* 4 months and 10 days.

4. *A* owes *B* £. 2000, to be paid three months hence; but *A* agrees to pay him £. 1200 down, provided he will give him a longer time for the payment of the remainder. The queſtion is, how long time *B* ought to give him to pay the other £. 800 in? *Anſ.* 7$\frac{1}{2}$ months.

Tyro. What other rules are there in common *Arithmetic?*

Philo. Several others, as *Allegation*, *Medial*, and *Alternate*, *Single* and *Double Poſition*, *Compoſition of Medicines*, *Arithmetical* and *Geometrical Progreſſion*, &c. but theſe being not ſo much required in buſineſs (or at leaſt may be done by the *Rule of Three Direct*) I ſhall give a little notion of the two laſt, becauſe it may be of ſervice to you, in caſe your fancy ſhould turn to any part of the mathematical ſtudies.

DIALOGUE IX.

SECTION I.

Of ARITHMETICAL PROGRESSION.

Tyro. WHAT do you mean by *Arithmetical Progreſſion?*

Philo. *Arithmetical Progreſſion* is by ſome called *Comparative Arithmetic*, becauſe in a ſeries of numbers one is compared with another, in order to know what ratio or proportion one bears to the other; that is, in what manner they differ, and how much, and that difference is always equal in numbers that are continued.

OBSERVATION.

1. Let us take any numbers that differ alike from one another: thus, 3, 6, 9, 12, 15, &c. differ by 3, called the common exceſs, difference, or ratio. Alſo, 1, 9, 17, 25, 33, are numbers in *Arithmetical Progreſſion*, whoſe ratio or common difference is 8.

2. In any ſeries of figures in *Arithmetical Progreſſion*, when the number of places is odd, *viz.* 3, 7, 11, 15, 19, or the like, the double of the middle figure, or place, is equal always to the ſums of the firſt and laſt figure; thus, 2, 6, (10,) 14, 18. The double of the middle term 10 is equal to the ſum of the firſt and laſt number, *viz.* 20. So 3, 8, 13, (18,) 23, 28, 33. The middle term 18 doubled is equal to the ſum of 3 and 33, *viz.* 36.

Tyro. How many caſes are there in this *rule?*

Philo. Six; but two of them will be ſufficient for your purpoſe, in working queſtions in general, or to give you a true notion of the nature of the rule itſelf.

CASE 1.

The number of places or terms, and the *ratio*, or common exceſs, being given, to find that laſt number:

Multiply the number of places leſs by 1, by the *ratio*, or common exceſs, and to that product add the firſt number, and that ſum will be equal to the laſt number.

1. Let the firſt number be 3, number of places 7, and common exceſs 5, what is the laſt number?

Here the number of places is 7, therefore I count them for 6 (which is leſs 1) and the *ratio*, or common exceſs is 5; now five times 6 is 30; then I add the firſt number, *viz.* 3, and it is 33, the laſt number, and ſo on, if the places were ever ſo many.

2. Let the number of terms be 121, the firſt number 5, and the common exceſs or *ratio* 9; I demand the laſt number?

Here the number of places leſs by 1 is 120, which multiplied by 9, the *ratio*, gives 1080, to which add the firſt number 5, gives 1085, the laſt number. And this you may prove by ſetting them down thus, 5, 14, 23, 32, 41, till you have 121 places, and your laſt number will be 1085. But how tedious is this! ſince you ſee the laſt number is ſo eaſily found.

A QUESTION *for Exerciſe.*

A traveller ſat out, and the firſt day went 6 miles, the ſecond day 9, increaſing every day's journey 3 miles, and travelled 61 days; how many miles did he go the laſt day? *Anſ.* 186 miles. See the next *Caſe*.

CASE 2.

The extremes, that is, the firſt and laſt number, and the number of terms being given, to find the aggregate, or total ſum of all the ſeries of numbers:

Add the firſt and laſt numbers together, and multiply that ſum by half the number of places, and the product is the ſum of all the ſeries. Or, in caſe the number of terms be odd, then add the firſt and laſt numbers together, and multiply that ſum by the number of the terms, and divide that product by 2, and you have the total of all the places.

Thus, in the laſt queſtion concerning the travels, the firſt number is 6, the laſt number 186 miles, and the places 61. Therefore, by the rule, add the firſt number 6, and the laſt number 186 together, and it is 192, which I multiply by 61, and it is 11712, and dividing by 2, I have 5856, the miles he went in all, in 61 days.

A QUESTION *for Exerciſe.*

Queſt. 2. Suppoſe 100 ſtones be placed in a ſtrait line, at a yard diſtance from each other, and a perſon undertakes to pick up one at a time, and bring it back to the place where he firſt ſet out; how far will he have gone when he has picked up the whole?

Here the number of places are 100, and as the ſtones are but one yard from each other, the common exceſs is but 1, and therefore the laſt number is alſo 100. But here you are to conſider, the man is to come back with every ſtone; therefore, when he fetches the firſt ſtone, in coming back he goes two yards to put in the firſt ſtone, therefore 2 is your firſt number, and by the ſame rule 200 will be your laſt number.

Laſt number 200
Firſt number 2

202
Half of the number of places 50

He goes in all —— 10100 *Yards*

Which reduced into miles, is 5½ miles, and 420 yards, which wants but 20 yards of 5¾ miles.

Queſt. 3. Suppoſe ſtones were laid one yard aſunder, in a right line, for one mile in length, and to be picked up one by one, coming back with one at a time; how far would the perſon go that performs it? *Anſ.* 1761 miles.

SECTION II.

Of GEOMETRICAL PROGRESSION.

Tyro. I Am mightily pleaſed with what you have ſhewn me; but pray what is *Geometrical Progreſſion*, and wherein does it differ from the other?

Philo. *Geometrical Progreſſion*, or *Proportion*, is when numbers differ from one another, by the like *ratio*, or reaſon, as in *Arithmetical Progreſſion*, only with this difference, that the former is the effect of *Addition*, and here of *Multiplication*, all the numbers having one common multiplier. As 2, 4, 8, 16, differ by double reaſon, or the *ratio* is 2; for twice 2 is 4, twice 4 is 8, *&c.* So alſo, 1, 7, 49, 343, *&c.* Here the *ratio* is 7, for 7 times 1 is 7, and 7 times 7 is 49, *&c.* So that you ſee it is *Multiplication*.

Tyro. I thank you, Sir: What elſe, pray?

NOTE 1.

Philo. Any three numbers differ in *Geometrical Progreſſion*; the product of the *extremes*, that is, the product of the *firſt* and *laſt* numbers, is equal to the ſquare of the *mean*, that is, equal to the middle number multiplied by itſelf.

Let 4, 12, and 36 be the 3 numbers, whoſe *ratio* is 3, that is, each is 3 times more than the foregoing number; then will the product of the extremes 4 and 36 be equal to the ſquare of 12, the *mean*, *viz.* equal to 144. So alſo 2, 16, and 128. Here 128 multiplied by 2 is equal to 16 multiplied by 16 equal to 256.

NOTE 2.

Any four numbers that differ in *Geometrical Proportion*, either continued or interrupted (provided the interruption or breaking off be between the *ſecond* and *third* numbers)

numbers) the product of the *mean* is equal to the product of the *extremes*; that is, the product of the *firſt* and *fourth* is equal to the product of the *ſecond* and *third* numbers.

Let the 4 numbers be 3, 12, 48, and 192, whoſe *ratio* is 4. Here 192 multiplied by 3, the *firſt* number, is equal to 48 by 12, *viz.* equal to 576.

Again, Suppoſe the numbers be interrupted, as 5, 30, 448, and 2688. Here the *ſecond* term is 6 times more than the *firſt* term, and the *fourth* term 6 times more than the *third*; therefore, 2688 multiplied by 5 is equal to 448 multiplied by 30.

Note, This mark (÷) ſtands for *Geometrical Progreſſion.*

NOTE 3.

The *ratio* of any numbers in ÷ is found by dividing any conſequent by its antecedent, that is, dividing any number by the foregoing number. Thus the *ratio* of the laſt numbers is found by dividing 30 by 5, or 2688 by 448, which gives 6, the *ratio.*

Tyro. I underſtand this very well; but in a long ſeries of numbers, how am I to find the laſt number?

Philo. This is very eaſily done, and as you have not the rule in many, or, at leaſt, have it but for certain *ratio*, or difference of numbers, I ſhall give you one ſtanding rule, be the firſt number and the *ratio* what it will.

CASE 1.

To find the laſt number in any ſeries in ÷ having the *firſt* number and *ratio* given, ſet down your *firſt* number, and multiply it by the *ratio*, and that product again by the *ratio*, or common difference, and thus go on for 5 or 6 terms, at pleaſure; then multiply any of thoſe places by itſelf, and divide the product thereof by the *firſt* number, and it will be the double of that number, wanting one place. Thus, ſuppoſe you multiply the 6th place by itſelf, and divide by the *firſt* number, the quotient will be the 11th place; then if you multiply the 11th place by itſelf, and divide by the *firſt* number, the quotient will be the 21ſt place, which is the double of 11, wanting 1.

☞ N. B. When the firſt term is unity, or 1, there is no occaſion to divide; for having multiplied by the *ratio* a few times, as before directed, (ſuppoſe as far as the 6th place) this term multiplied by itſelf will be the product of the double of terms wanting 1, as was ſaid before.

Tyro. I am obliged to you, Sir; but how ſhall I find the ſum of all theſe ſeries?

Philo. By the next caſe.

CASE 2.

The ratio *(or common difference) and the laſt number being given, to find the aggregate or total ſum of all the ſeries:*

1. Multiply the laſt term, or number, by the common difference, or *ratio*, and from that product take the *firſt* number: then divide the remainder by the common difference, leſs 1, and the quotient will be the ſum of all the ſeries. Or,

2. Multiply the *ſecond* and laſt term together; then multiply the *firſt* term into itſelf, and take that product from the product of the *ſecond* and laſt term; then divide the remainder by the *ſecond* term, leſs 1, the *firſt* term will give the ſum of all the ſeries.

Tyro. Pleaſe to give me one example.

Philo. I will give you a practical queſtion to exerciſe both caſes.

Queſt. A cunning jockey had a fine gelding, to which a gentleman took a particular fancy, and after many words had paſſed between them, the jockey agreed to ſell him to the gentleman for the price his ſhoes would come to, at one farthing for the *firſt* nail, and to double the price every nail. Now the number of nails in the gelding's ſhoes were 28, I demand then what he was ſold for at this rate?

Now, obſerve, *Tyro*, here the common exceſs is 2, (that is a farthing a nail doubled:) Now to find the laſt number by *Caſe* 1, double a few places, ſuppoſe as far as the 7th, which will be 64; then multiply 64 by itſelf, *viz.* 64, you have 4096, the 13th place, which doubled gives the 14th place, *viz.* 8192. This multiplied by itſelf gives the 27th place, which doubled, gives the 28th or laſt place, *viz.* 134217728 farthings; then proceed according to *Caſe* 2, you will find the ſum of all the ſeries to be 268435455 farthings, which is £. 279620-5-3¾, a ſum too large for the ignorant purchaſer. And had there been but four nails more in his ſhoes, (*viz* 32) he would have come to £. 4473924 - 5*s.* *

* It is no eaſy taſk to make ſome perſons believe the truth of the increaſe of figures in Geometrical Progreſſion in theſe queſtions; but ſuppoſe a ſervant was to agree with his maſter to ſerve him thirty years, for 1 ſingle wheat corn the firſt year, for the ſecond year 10, for the third 20, and ſo on. The produce of the wheat would be more than all the ſhips in England could carry away at once; and the money for his wages would be more than all the land could pay, if ſold at 30 years purchaſe for ever.

SECTION III.

Of PERMUTATION, *or Variety of Changes.*

Tyro. I Imagine this is much after the ſame manner as *Progreſſion*; is it not?

Philo. This ſhews the increaſe of numbers as well as the other; but does not teach you to find the ſum of all, only their different variations or changes, as follows:

Multiply every number together, that is, the *firſt* by the *ſecond*, and that product by the *third* figure, and ſo on till you have gone through all the given numbers, ſo is the laſt product the variety of changes.

EXAMPLE.

EXAMPLE.

I demand the changes that may be rung on 12 bells, or the different poſition 12 perſons may ſit at table? *Anſ.* 479001600.

☞ *Note*, This ſign (×) ſignifies that all numbers between which it ſtands are to be multiplied continually one into the other, thus: take the 12 bells, and multiply the *firſt* by the *ſecond*, you have two changes upon two bells; multiply this by the third bell, you have 6 on three bells; multiply this product by 4, or the *fourth* bell, you have 24 changes, *&c.* as follows:

Thus, 1×2×3×4×5×6×7×8×9×10×11×12 will produce 479001600 changes or different poſitions, which you may prove very eaſily at leiſure by *Multiplication* only.*

Tyro. I thank you for giving me a ſhort hint of theſe things, which I perceive the nature of very plainly: And now, pray, what will you inſtruct me in next?

Philo. There are two or three rules, ſuch as the *Rule of Falſe*, *Allegation*, *Alternate*, *Compoſition of Medicines*, which are not material in buſineſs, and therefore for want of room muſt be omitted, and the more neceſſary part, viz. *Vulgar Fractions*, be treated of in their ſtead. And here I beg you would take care and make yourſelf maſter of *Vulgar Fractions*, they being very neceſſary in almoſt every branch of life, and the very foundation of *Decimals*.

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* Notwithſtanding the changes on 8 bells may be rung out in a few hours, yet the changes on 12 (allowing 10 changes in a minute) will take 91 years, 49 days; and add to the incredibility of this increaſe two bells more, viz. 14, would take up 16575 years to ring the changes through. See Mr. Ward, p. 85.

DIALOGUE XII.

SECTION I.

Of Notation of VULGAR FRACTIONS.

Tyro. WHAT do you mean by *Notation?*

Philo. Notation, like *Numeration*, ſhews you how to note, write down, or expreſs any *Fraction.*

Tyro. What is a *Vulgar Fraction?*

Philo. It is a broken number, or a part or parts of an integer or whole number, and conſiſts of two parts, *viz.* the *Numerator*, which always ſtands a-top, and the *Denominator*, which always ſtands under it, or below. Thus, $\frac{4}{5}$, $\frac{3}{4}$, $\frac{11}{12}$. Here 4, 3, and 11, are the *Numerators*, and 5, 4, and 12, the *Denominators.*

Tyro. How many ſorts of *Vulgar Fractions* are there?

Philo. Three, *viz. Firſt*, *Simple*, *Single*, or *Proper Fractions*, (for theſe are all one.) *Secondly*, *Improper*; and *thirdly*, *Compound Fractions.*

Tyro. What is a *Simple Fraction*, or how is it known?

Philo. Simple Fractions have their *Numerators* leſs than their reſpective *Denominators.* Thus, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{5}{8}$, $\frac{14}{87}$, are all *Simple Fractions.*

Tyro. What is an *Improper Fraction?*

Philo. Improper Fractions have their *Numerators* larger than their *Denominators.* Thus, $\frac{4}{3}$, $\frac{9}{5}$, $\frac{87}{14}$, $\frac{127}{2}$, &c. are *Improper Fractions.*

Philo. Compound Fractions are *Fractions of Fractions*, compounded or joined together by the word *of.* Thus, $\frac{2}{3}$ of $\frac{3}{5}$, or $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{11}{12}$ are *Compound Fractions*, and are thus read: 2 thirds of 3 fifths, or 3 fourths of 5 ſixths of 11 twelfths of an *integer* or *whole number.*

Tyro. I underſtand you, Sir; but this is very difficult to tell, ſurely.

Philo. You have nothing to do with this at preſent; you will know it by and by.

Tyro. What do you mean by a *mixt number?*

Philo. A *mixt number* is a *whole number*, with a fraction after it. Thus, $14\frac{2}{5}$, and $147\frac{5}{8}$, are *mixt numbers.*

Tyro. I underſtand you; but how am I to find the value of different *fractions?*

Philo. By *Reduction*, which is always learned firſt, becauſe you can't *add*, *ſubtract*, *multiply*, or *aivide*, 'till the fractions are firſt reduced to their proper order: but before you proceed any further, it will be proper to learn the following ſigns or characters by heart, ſo as to know what they ſignify, which will be a great help to you.

Of the Signs uſed in Vulgar Fractions.

This ($=$) is the ſign of *Equality*, and ſignifies that the numbers before it are equal to thoſe after it. Thus, 5 and $2=7$ is thus read, 5 and 2 is *equal* to 7.

This mark ($+$) is the ſign of *Addition*, and ſignifies all the numbers are to be added together. Thus, $2+6+7=15$: That is, 2 *more*, 6 *more*, 7 *more*, or 2 added to 6 and 7 is *equal* to 15.

This ($-$) is the ſign of *Subtraction*, and ſignifies the number after it is taken, or is to be taken out of the number before it. Thus, $15-7=8$, that is, 7 taken or ſubtracted from 15, is *equal* to 8.

This ($\times$) is the ſign of continual *Multiplication*.

This ($\div$) is the ſign of *Diviſion*, and ſignifies the number before it is to be divided by the number that follows it. Thus, $56\div8=7$, that is, 56 divided by 8 is *equal* to 7.

SECTION II.

REDUCTION OF VULGAR FRACTIONS.

CASE 1.

To reduce a Mixt Number *to an* Improper Fraction.

MULTIPLY the whole number by the denominator of the fraction, and take in the numerator beſides; then place the denominator under the product, and it is done.

Reduce $57\frac{3}{5}$ to an improper fraction.

$$\begin{array}{l} 57\frac{3}{5} \\ \underline{\quad 5} \\ 288 \\ \hline \quad 5 \end{array} \quad \textit{Anſ.}\ \frac{288}{5}$$

Reduce $1753\frac{11}{12}$ to an improper fraction. *Anſ.* $\frac{21047}{12}$.

CASE 2.

To reduce an Improper Fraction *to a* Whole *or* Mixt Number.

Divide the *mumerator* by the *denominator*, and if any thing remains, place it for a new *numerator* over the *denominator*.

Reduce $\frac{288}{5}$ to a *mixt number*.

$$\begin{array}{l} 5)288 \\ \hline 57\frac{3}{5}\ \textit{Anſ.} \end{array}$$

Reduce $\frac{21047}{12}$ to a *mixt number*. *Anſ.* $1753\frac{11}{12}$.

☞ This is only a proof to the foregoing *caſe*, and is the ſame queſtion backwards.

CASE 3.

To reduce or make a Whole Number into an Improper Fraction.

Multiply the whole number by any figure at pleaſure, and place the product over the figure you multiplied by, and you have an *improper fraction* equal to the given *whole number*.

Reduce 14 to an *improper fraction*, whoſe denominator muſt be 9. *Anſ.* $\frac{126}{9}$.

Here, becauſe it ſays 9 muſt be the denominator, I multiply 14 by 9, and it is 126, which I place over the 9, and it is done. *Anſ.* $\frac{126}{9}$.

NOTE 1.

To expreſs any *whole number* fraction-wiſe, it is only putting unity or 1 under it. Thus, 14, 26, 490, &c. will be $\frac{14}{1}$, $\frac{26}{1}$, $\frac{490}{1}$, &c. Remember this, for it is very uſeful.

NOTE 2.

Every *improper fraction* is more than an unit or 1, and every *ſimple fraction* is leſs than unity or 1. Thus, the *ſimple fraction* $\frac{3}{4}$ of a £. ſterling is but 15 ſhillings: but $\frac{4}{3}$ of a £. ſterling is £. 1, and $\frac{1}{3}$ over; for if you divide 4 by 3, it is 1 and $\frac{1}{3}$, that is, £. 1-6-8.

NOTE 3.

When the numerator and denominator are alike, the fraction is equal to a whole number. Thus, $\frac{4}{4}$ is 1, or $\frac{25}{25}$ is equal to 1; becauſe the numerator divided by the denominator produces 1.

CASE 4.

To reduce a Compound Fraction *to a* Simple *one, of the ſame Value.*

Multiply all the numerators together for a new numerator, and all the demominators for a new denominator.

Note, *N. N.* ſignifies *new numerator*, and *N. D. new denominator*, and *C. D. common denominator*, which pray remember.

1. Reduce $\frac{2}{5}$ of $\frac{3}{4}$ of $\frac{5}{8}$ to a *ſimple fraction ?* *Anſ.* $\frac{30}{160}$.
For $2\times3\times5=30$ *N. N.* and $5\times4\times8=160$ *N. D.*

That is, 2 multiplied by 3, and that product by 5, is equal to 30 *N. N.* and 5 multiplied by 4, and that product by 8, is equal to 160 *N. D.* *Anſ.* $\frac{30}{160}$.

*** *Note*, When there are cyphers in the numerator and denominator, then cut them off, and the *fraction* is ſtill the ſame. Thus, in the foregoing anſwer, the *fraction* is $\frac{30}{160}$, *viz.* $\frac{3}{16}$. So $\frac{4000}{7000}$ is only $\frac{4}{7}$.

2. Reduce $\frac{3}{5}$ of $\frac{5}{6}$ of $\frac{7}{8}$ of $\frac{11}{12}$ to a *ſimple fraction.* *Anſ.* $\frac{1155}{2880}$.

CASE 5.

To reduce a Fraction *to its loweſt Term, that ſhall be equal to the original given* Fraction.

Divide the numerator and denominator by any figure that will divide them without any remainder; ſo ſhall the laſt quotient be a new numerator, and a new denominator equal to the given fraction.

1. Reduce $\frac{72}{120}$ into its loweſt terms? *Anſ.* $\frac{3}{5}$.

Diviſors, $\overset{2}{\smile}\ \overset{6}{\smile}\ \overset{2}{\smile}$

$\frac{72}{120}\Big|\frac{36}{60}\Big|\frac{6}{10}\Big|\frac{3}{5}$ *Anſ.* $\frac{3}{5}=\frac{72}{120}$. So alſo $\frac{168}{448}$ is $=\frac{3}{8}$, which you may prove by dividing the numerator and denominator by any figure that will divide them both, as was ſaid before.

Note, There is another way to reduce a fraction to its loweſt terms at once, and that is by finding a common meaſure.

To find a Common Meaſure.

Divide the denominator by the numerator, and if any thing remains, divide the laſt diviſor by ſuch remainder, and if any thing again remains, divide the laſt diviſor thereby: thus go on till nothing remains, and your laſt diviſor is the *common meaſure*, or number that will divide the numerator and denominator at once into their loweſt terms.

1. Reduce $\frac{168}{448}$ into its loweſt terms. *Anſ.* $\frac{3}{8}$.

```
              168)448(2
                  336
                  ———
                  112)168(1
                      112
                      ———
Common Meaſure         56)112(2
                          112
                          ———
                            0
```

Here I divide the *denominator* 448, by the *numerator* 168, and 112 remains; then I divide 168, the laſt diviſor, by that 112, and 56 remains; *laſtly*, I divide 112 by 56, and 0 remains: ſo is 56 the *common meaſure*, that will divide both at one work.

```
56)168(3 N. numerator        56)448(8   N. denominator
   168                          448
 ———                          ———   Anſ. 3/8 = 168/448.
   0                             0
```

2. Reduce $\frac{512}{1280}$ to its loweſt terms. *Anſ.* $\frac{2}{5}$.

CASE

CASE 6.

To reduce Fractions of different Denominators to Fractions of the ſame Value, having one common Denominator.

Firſt, Multiply all the denominators together, for a common denominator; then begin with the firſt numerator, and multiply it into all the denominators, except its own denominator: do thus with all the other numerators, multiplying them into all the denominators except their own; ſo will theſe products be *new* numerators, which muſt be placed over the *common* denominator, and each *fraction* will be equal to *that* fraction whoſe numerator you multiplied into the denominators.

1. Reduce $\frac{2}{3}$, $\frac{3}{5}$, and $\frac{5}{8}$ to fractions, having one *common* denominator.

Firſt, I multiply all the denominators together, and it makes 120 for a *common* denominator. That is, $3\times5\times8=120$ *C. D.* Then I begin with the numerator 2, that is, $2\times5\times8=80$ *N. N.* Then the numerator $3\times3\times8=72$ *N. N.* And *laſtly*, $5\times5\times3=75$ *N. N.* Theſe new numerators I place over the *common* denominator, and the work is done. Thus, $\frac{80}{120}=\frac{2}{3}$, for 80 is $\frac{2}{3}$ of 120. Alſo, $\frac{72}{120}=\frac{3}{5}$, and $\frac{75}{120}=\frac{5}{8}$.

2. Reduce $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$, and $\frac{4}{5}$ to fractions having one *C.* denominator. *Anſ.* $\frac{720}{960}=\frac{3}{4}$, $\frac{800}{960}=\frac{5}{6}$, $\frac{840}{960}=\frac{7}{8}$, and $\frac{768}{960}=\frac{4}{5}$.

CASE 7.

To reduce Fractions *of one Name or Denomination to another.*

1. ASCENDING.

When a *fraction* is to be reduced from a leſs to a greater denomination, then make the given *fraction* into a compound *fraction*, by conſidering how many of the *leſs* make one of the *greater* denomination; then reduce this *compound fraction* to a ſimple one, and it is done.

1. Reduce $\frac{1}{4}$ of a penny to the fraction of a £. ſterling. *Anſ.* £. $\frac{1}{960}$.

Here, becauſe 12 pence make 1 ſhilling, and 20 ſhillings a £. I ſay, $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$, which reduced to a *ſimple fraction* by multiplying the numerators together for a *N. N.* and all the denominators for a *N. D.* gives $\frac{1}{960}$ of a £.$=\frac{1}{4}$ of a penny.

2. Reduce $\frac{3}{4}$ of a farthing to the fraction of a guinea. *Anſ.* $\frac{3}{4032}$, *viz.* $\frac{3}{4}$ of $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{21}=\frac{3}{4032}$. *Anſ.*

3. Reduce $\frac{1}{4}$ of a *lb.* to the fraction of a ton. *Anſ.* $\frac{1}{8960}$.

2. DESCENDING.

When the *fraction* is to be brought from a *greater* to a *leſs* denomination, then make of it a *compound fraction*, as before; deſcending from the *great* to the *leſſer* denomination: then multiply every denominator by the numerator of the given *fraction* (except its own denominator) and place the product over the denominator to the ſaid given fraction, and you have the anſwer.

N. B. This *caſe* is a proof to the laſt.

1. Reduce $\frac{1}{960}$ of a £. ſterling to the fraction of a penny. *Anſ.* $\frac{240}{960}$, or $\frac{1}{4}$. For $\frac{1}{960}$ of $\frac{1}{20}$ of $\frac{1}{12}$. Now the numerator 1 multiplied into the denominator 20, and 12 is $=240$, which I place over the denominator 960, thus, $\frac{240}{960}$. *Anſ.*

2. Reduce $\frac{3}{4032}$ of a guinea to the fraction of a farthing. *Anſ.* $\frac{3024}{4032}$. For it is $\frac{3}{4032}$ of $\frac{1}{21}$ of $\frac{1}{12}$ of $\frac{1}{4}$. Now $3\times21\times12\times4=3024$. *N. N.*

CASE 8.

To find the Value of a Fraction *in* Money, Weight, *or* Meaſure.

Multiply the numerator of the fraction by the next neareſt part belonging to the integer itſelf, and divide by the denominator; then multiply the remainder by the next neareſt part of the integer, and divide by the ſame diviſor or denominator, and thus go on 'till you have gone through all the parts of the integer, and the quotients will be your anſwer.

1. What is the value of $\frac{26}{30}$ of a £. ſterling? *Anſ.* 17*s.* 4*d.*

```
       26 numerator
       20
     ------
  3|0)52|0
     ------
     17s. 10s.
          12
     --------
    3|0)12|0
      ------
          4d.
```

Here I multiply the numerator 26 by 20, the ſhillings in a £. and divide by the denominator 30, gives 17*s.* and 10 over, which I multiply by 12, and divide again by 30, gives 4 pence; therefore I find $\frac{26}{30}$ of a £. to be 17*s.* 4*d.*

2. What is the $\frac{15}{216}$ of a moidore? *Anſ.* 1*s.* 10$\frac{1}{2}$*d.* as by the following work.

15 *numerator*
27 *multiply*

216)405(1*s.*
216

189
12

216)2268(10*d.*
216

108
4

216)432(2 *qrs.*

0

Anſ. 1*s.* 10$\frac{1}{2}$*d.*

Here I multiply the numerator 15 by 27, the ſhillings in a moidore, and divide by the denominator, gives 1 ſhilling, and 189 over, which I multiply by 12, and divide by 216, as before, and ſo I go on, as appears by the work, and find $\frac{15}{216}$ of a moidore to be 1*s.* 10$\frac{1}{2}$*d.*

Tyro. I ſee the nature of it plainly; and like this *caſe* very well; for it is diverting, as well as improving.

Philo. You are to proceed the ſame in *weight* and *meaſure*; therefore I ſhall only ſet you a few queſtions for practice to try at leiſure.

3. What is the $\frac{324}{972}$ of a ton? *Anſ.* 6 *C.* 2 *qrs.* 18 *lbs.* 10 *oz.* 10 *dr.* $\frac{648}{972}$.

4. What is the $\frac{14}{112}$ of a barrel? *Anſ.* 4$\frac{1}{2}$ *gallons.*

5. What is the $\frac{150}{225}$ of a mile? *Anſ.* 1173 *yards*, 1 *foot.*

6. What is the $\frac{14}{16}$ of an acre? *Anſ.* 3 *roods*, 20 *rods*.

7. What is the $\frac{5}{12}$ of a year (allowing 365 days)? *Anſ.* 152 *days*, 2 *hours*.

SECTION III.

ADDITION of VULGAR FRACTIONS.

Tyro. HOW are *Vulgar Fractions* added together? *Philo.* Very eaſily, by this one rule, *viz.* All *compound fractions* muſt be reduced to *ſimple* ones, and all fractions of different denominations to a *compound* denominator; then add all the numerators together, and place their ſum over the *common* denominator, is the anſwer; and if it be an improper fraction at laſt, then reduce it to a *mixt* number, and the work is done.

1. Add $\frac{1}{11}$, $\frac{2}{11}$, $\frac{3}{11}$, and $\frac{4}{11}$ together? *Anſ* $\frac{10}{11}$.

Here being one *common* denominator to all the fractions, I only add the numerators together, and the work is done. *Anſ.* $\frac{10}{11}$.

2. Add $\frac{25}{27}$, $\frac{14}{27}$, and $\frac{19}{27}$ together. *Anſ.* $\frac{58}{27}=2\frac{4}{27}$.

Here I find the ſum of all the numerators to be 58, which I place over the denominator 27; but being an *improper* fraction, I divide 58 by 27, and have for *anſwer* 2 and $\frac{4}{27}$.

3. Add $\frac{2}{3}$, $\frac{3}{5}$, and $\frac{5}{8}$ together. *Anſ.* $\frac{227}{120}$.

Here the *fractions* having different denominators, I reduce them (by *caſe* 5) to a common denominator, and find them to be $\frac{80}{120}$, $\frac{72}{120}$, and $\frac{75}{120}$. Then I add theſe numerators together, and find them 227: ſo the anſwer is $\frac{227}{120}=\frac{107}{120}$.

4. Add $\frac{2}{3}$ of $\frac{3}{5}$ and $\frac{1}{2}$ of $\frac{3}{8}$ together. *Anſ.* $\frac{141}{240}$.

Firſt, $\frac{2}{3}$ of $\frac{3}{5}$ is $=\frac{6}{15}$, and $\frac{1}{2}$ of $\frac{3}{8}=\frac{3}{16}$. Now $\frac{3}{16}$ and $\frac{6}{15}$ reduced to a *C. D.* is $\frac{45}{240}$ and $\frac{96}{240}$, which added together is $\frac{141}{240}$. *Anſ.*

5. Add £. 14$\frac{3}{5}$, £. 19$\frac{2}{3}$, £. 47$\frac{5}{8}$, and £. 100 together. *Anſ.* £. 181 $\frac{112}{120}$, or = 18*s.* 4*d.*

6. What muſt I add to £. 54$\frac{2}{3}$ and £. 19$\frac{3}{5}$ to make it £. 100? *Anſ.* £. 25$\frac{11}{15}$.

SECTION IV.

SUBTRACTION OF VULGAR FRACTIONS.

Tyro. HOW is *Subtraction of Fractions* performed?

Philo. By the ſame rule as in *Addition*, firſt reducing all *compound* to *ſimple*, and all to a *common* denominator; thus, *ſubtract* the numerator or the *leſs* fraction from the numerator of the other, and place the difference over the denominator, is the anſwer.

From —	$\frac{14}{29}$		From	£. 67$\frac{21}{47}$
Take —	$\frac{11}{29}$		Take	18$\frac{4}{47}$
Difference	$\frac{3}{29}$ *Anſ.*			49$\frac{17}{47}$ *Anſ.*
Proof	$\frac{14}{29}$		Proof	67$\frac{21}{47}$

Here in both theſe examples I take the numerator of the *leſs* fraction from the numerator of the top, or *greater* fraction, and place the difference over the denominator. Then I prove the work, as in common *Subtraction*, by adding the numerator of the difference to the numerator of the *leſs* fraction, and it gives the numerator of the top fraction. And thus for all examples of this ſort.

Tyro. I underſtand you very well, ſir; but ſuppoſe the numerator of the fraction to be ſubtracted be larger than the numerator of the fraction I am to take it out of, how am I to do then?

Philo. This is eaſy enough; for when you cannot take the lower numerator out of the top numerator, then take it out of the common denominator, and to that difference add the top numerator, and place it over the denominator for the true difference; only pray remember this is called *borrowing*, as in common *Subtraction*, and you muſt carry 1 to the next figure for ſo doing.

2. Lent	$134\frac{14}{24}$	is =	£. 134 - 11 - 8	*The* PROOF
Received	$95\frac{18}{24}$	is =	95 - 15	*by common*
				Subtraction.
Due	$38\frac{20}{24}$ *Anſ.*	is =	£. 38 - 16 - 8	
Proof	$134\frac{14}{24}$	Proof	£. 134 - 11 - 8	

From $\frac{2}{3}$ of $\frac{3}{5}$ take $\frac{1}{2}$ of $\frac{3}{8}$. That is, from $\frac{6}{15}$ take $\frac{3}{16}$. Now $\frac{6}{15}$ is $\frac{96}{240}$, and $\frac{3}{16}$ is $\frac{45}{240}$. Then I take $\frac{45}{240}$ from $\frac{96}{240}$, and there remains $\frac{51}{240}$. *Anſ.*

4. From 1 take $\frac{4}{11}$. *Anſ.* $\frac{7}{11}$. For I make an *improper* fraction equal to 1, which has a denominator equal to the fraction to be ſubtracted, *viz.* $\frac{11}{11}$ is = 1. Then $\frac{7}{11}$ from $\frac{11}{11}$ remains $\frac{4}{11}$. And thus for any other example.

SECTION

SECTION V.

MULTIPLICATION OF VULGAR FRACTIONS.

Tyro. HOW is *Multiplication* performed?

Philo. The fractions muſt be reduced to ſimple ones, as before directed, and mixt numbers to improper fractions. Then the rule is, multiply the numerators together for a new numerator, and the denominators together for a new denominator, and the work is done.

1. Multiply $\frac{4}{7}$ by $\frac{3}{6}$. *Anſ.* $\frac{12}{42}$. For $4\times3=12$. *N. N.* $7\times6=42$. *N. D.*

2. Multiply $\frac{247}{6}$ by $\frac{4}{9}$. *Anſ.* $\frac{988}{54}=18\frac{16}{54}$.

3. Multiply $4\frac{1}{2}$*d.* by $4\frac{1}{2}$*d.* *Anſ.* $20\frac{1}{4}$*d.*

Firſt, I reduce $4\frac{1}{2}$ to an improper fraction, which is $\frac{9}{2}$; therefore I multiply $\frac{9}{2}$ by $\frac{9}{2}$. *Anſ.* $\frac{81}{4}=20\frac{1}{4}$, as before.

4. Multiply £. $4\frac{3}{8}$ by £. 2. Here £. $4\frac{3}{8}=\frac{35}{8}$, and £. 2 is expreſſed in fractions $\frac{2}{1}$; therefore multiply $\frac{35}{8}$ by $\frac{2}{1}$. *Anſ.* $\frac{70}{8}=$ £. $8\frac{6}{8}$, viz. £. 8 - 15.

5. Multiply $\frac{2}{3}$ of $\frac{5}{8}$ by $\frac{3}{7}$ of $\frac{1}{5}$, that is, $\frac{10}{24}$ by $\frac{3}{35}$. *Anſ.* $\frac{30}{840}=8\frac{3}{84}$. And thus may any ſum be multiplied by another, with more exactneſs than by any other rule, though not ſo eaſily as *Decimal Fractions*.

SECTION VI.

DIVISION OF VULGAR FRACTIONS.

Tyro. HOW is *Diviſion of Fractions* performed?

Philo. Firſt reduce all compound to ſimple fractions; and all mixt numbers to improper fractions, as before directed; then the rule is, multiply the numerator of the dividend into the denominator of the diviſor, for a new numerator, and the numerator of the diviſor (or fraction you divide by) into the denominator of the dividend for a new denominator, and you have the anſwer.

1. Divide $\frac{8}{19}$ by $\frac{5}{12}$. *Anſ.* $\frac{96}{95}=1\frac{1}{95}$. Here I multiply 8 into 12, which is 96, for a new numerator, and 5 into 19, which is 95, for a new denominator, which is $\frac{96}{95}$. Here you ſee the anſwer is an improper fraction; but if you change the fractions, that is, if $\frac{5}{12}$ were to be divided by $\frac{8}{19}$, then the anſwer would be $\frac{95}{96}$, which is a ſimple fraction.

Note, The character (÷) ſignifies diviſion, or that the number is divided by what follows it.

2. Divide £.$47\frac{1}{2}$ of $\frac{2}{3}$ by $\frac{2}{3}$ of $\frac{3}{5}$ of a £. *Anſ.* $\frac{4260}{36}$. For $\frac{1}{2}$ of $\frac{2}{3}=\frac{2}{6}$, and $\frac{2}{3}$ of $\frac{3}{5}=\frac{6}{15}$; therefore, divide £.$47\frac{2}{6}$ by $\frac{6}{15}$, that is, divide $\frac{284}{6}$ by $\frac{6}{15}$, Firſt, $284\times15=4260$ *N. N.* and $6\times6=36$ *N. D.* *Anſ.* $\frac{4260}{36}$, or £.$118\frac{12}{36}$ $=6s.\ 8d.$

Tyro. Then I perceive that *Diviſion of Fractions* makes more of a ſum after divided than before.

Philo. Yes, certainly, when the diviſor is a ſimple fraction, or leſs than unity, as in this caſe; and it anſwers the ſame end as common *Multiplication*, viz. increaſes the value.

Tyro. Explain this a little more, pray.

Philo. Obſerve then the following example.

3. It is required to bring 42 guineas into farthings by diviſion only?

Here by caſe 4, I reduce a farthing to the fraction of a guinea, and find it $\frac{1}{1008}$ for a diviſor. Then I make 42 guineas a dividend, thus, $\frac{42}{1}$. Now, $\frac{42}{1} \div \frac{1}{1008} =$ 42336 farthings.

☞ From hence, *Tyro*, ariſes this obſervation, that where any whole number is divided by a ſimple fraction, the quotient will be ſo much larger than the dividend, as the diviſor is leſs than the unity, or 1; but, on the contrary, when a ſimple fraction is to be divided by a whole number, then the quotient will be ſo many times leſs than the dividend, as the diviſor exceeds unity.

Thus £. 4 divided by $\frac{1}{4}$ of a £. is the ſame as to multiply it by £. 4, viz. £. 16: but $\frac{1}{4}$ divided by 4 is $= \frac{1}{16}$ only, viz. but 1*s.* 3*d.* *

And now, *Tyro*, we are come to that rule wherein all the others are exerciſed, viz.

SECTION VII.

The RULE OF THREE IN VULGAR FRACTIONS.

Tyro. HOW is this rule performed?

Philo. After having reduced compound fractions and mixt numbers as before directed, firſt (as in the common *Rule of Three)* make your firſt and third number of one name, then multiply your ſecond by your third, and divide by your firſt.

---

* See more of the nature of *Vulgar Fractions* in my *Young Algebraiſt's Companion*, dialogue 3, caſe 3, 4.

Or rather thus:

Having ſtated the queſtion, and reduced the fractions, multiply the denominator of the firſt number into the numerators of the ſecond and third numbers, for a new numerator, and the numerator of the firſt number into the denominator of the ſecond and third, for a new denominator, and that is your anſwer required.

1. If $\frac{3}{4}$ of a yard coſt $\frac{5}{6}$ of a £. what coſt $51\frac{1}{4}$ yards?

$$\begin{array}{r}4\\ \hline 205\\ \hline 4\end{array}$$

Thus $\frac{3}{4}$, $\frac{5}{6}$, $\frac{205}{4}$. Now I begin with the denominator of the firſt fraction, thus, $4\times5\times205=4100$ *N. N.* And $3\times6\times4=72$ *N. D.* So is the anſwer $\frac{4100}{72}$ of a £.=£.56 - 18 - 10 - 2*q.* $\frac{48}{72}$ or $\frac{2}{3}$.

2. If a load of wheat coſt £.$15\frac{2}{12}$, what coſt one buſhel?

Here, as 40 buſhels make one load, my firſt number will be $\frac{40}{1}$, the ſecond number reduced to an improper fraction is $\frac{182}{12}$, and 1 buſhel will be $\frac{1}{1}$. Then, if $\frac{40}{1}$ be $\frac{182}{12}$ what $\frac{1}{1}$. Now $1\times182\times1=182$ *N. N.* and $40\times12\times1=480$ *N. D.* *Anſ.* $\frac{182}{480}$, which is =7*s.* 7*d.*

Tyro. This is eaſy enough, if this be a general rule.

Philo. It is, and if you look over what has been done, you may with eaſe do any thing in this rule; therefore, I ſhall only ſet you a few queſtions for practice.

3. What is the intereſt of £. 219$\frac{2}{3}$ for one year, at £. 5$\frac{3}{8}$ per cent. *Anſ.* $\frac{28337}{2400}$, viz. £. 11 - 16 - 1 - 2*q*. $\frac{1920}{2400}=\frac{4}{5}$.

4. Bought South Sea ſtock to the value of £. 420 13*s*. 4*d*. and gave £. 95$\frac{4}{5}$ per cent. what comes it to? *Anſ.* £. 402 - 19 - 11 - 2*q*. $\frac{108}{150}$ or $\frac{18}{25}$.

5. A perſon left 40 ſhillings to 4 poor widows, A, B, C, and D. To A he left $\frac{1}{3}$, to B $\frac{1}{4}$, to C $\frac{1}{5}$, and to D $\frac{1}{6}$, deſiring the whole might be diſtributed accordingly; I demand the proper ſhare of each?

Take $\frac{1}{3}$, $\frac{1}{4}$, &c. of 40 ſhillings, and add them together, it makes but 38 ſhillings: then ſay,

If 38*s*. be $\frac{1}{3}$, viz. 13*s*. 4*d*. what will 40 be? Thus proceed with all their ſhares, you will find A muſt have 14*s*. $\frac{16}{38}$, B 10*s*. 6*d*. $\frac{12}{38}$, C 8*s*. 5*d*. $\frac{2}{38}$, and D 7*s*. 0*d*. $\frac{8}{38}$.

And now, *Tyro*, we will proceed to

DIALOGUE XIII.

SECTION I.

NOTATION OF DECIMAL FRACTIONS.

Tyro. WHAT do you mean by a decimal?

Philo. Any number, whether cyphers before it or not, having a dot before it, thus, .2, .005, or .4715, &c. are decimals.

Tyro. How are theſe decimals formed?

Philo. Every decimal is a vulgar fraction, having as many cyphers for its denominator and an unit beſides. Thus the foregoing decimals expreſſed in vulgar fractions are $\frac{2}{10}$, $\frac{005}{1000}$, and $\frac{4715}{10000}$, &c. but the denominators are caſt away in decimals, becauſe you ſee they are always known, and we work only with the numerator, or the decimal itſelf; and this is the reaſon that decimal fractions are ſo very eaſy to what vulgar are.

Tyro. I underſtand you, but have you no mixt numbers here as well as in vulgar fractions?

Philo. Yes: a whole number and a decimal after it is a mixt number. Thus, 47.5 or 5.25 are mixt numbers, ſignifying 47 whole numbers, and $\frac{5}{10}$ parts or $\frac{1}{2}$; and the other is 5 whole numbers, and 25 hundredth parts, or 1 quarter, for 25 is $\frac{1}{4}$ of 100.

Note, 1. Cyphers after figures are of no ſignification in decimals, thus, .5000 is but .5, and .750000 but .75, for .500 is $\frac{500}{1000}$, which is the ſame as $\frac{5}{10}$: but cyphers before decimals are neceſſary, for they decreaſe their value. Thus, .5 is 5 tenth parts, or $\frac{1}{2}$, but .05 is but 5 one hundredth parts, viz. $\frac{5}{100}$ in vulgar fractions.

Note 2. Pray remember this, that .5 ſignifies the half of any whole number, thing, or integer; .25 is one quarter, and .75 ſignifies three quarters. For 5 is $\frac{1}{2}$ of 10, 25 is $\frac{1}{4}$ of 100, and 75 is $\frac{3}{4}$ of 100.

This being well underſtood, you may proceed to *Addition*.

SECTION II.

ADDITION OF DECIMALS.

Tyro. HOW is *Addition of Decimals* performed?

Philo. The ſame as common *Addition*, only with this difference, that you muſt ſet tenths under tenths, and hundred parts under hundred parts, not regarding the number of decimal places, but ſet them all even towards the firſt left hand row that ſtands next the whole numbers, and then add them all together as in whole numbers.

One example well explained will be ſufficient, for you will ſee the reaſon more plainly in *Reduction*.

1. Add £. 47.45, .7259, 5.25, .000545, and 15.5 together.

```
  47.45
    .7259
   5.25
    .000545
  15.5
  ---------
Anſ. 68.926445
```

Here you ſee I place the whole numbers under one another, as in *Addition*, and the decimals I place even next the whole numbers, not regarding how far they extend to the right-hand: then I add them as they ſtand, like whole numbers.

2. Add .575, .005, .0005, .95, .3, and .675 together. *Anſ.* 2.5055. If you ſet theſe under one another, and add them as before, you will have 2 for a whole number, and .5055 for a decimal.

Note, Always remember to part the decimals from the whole numbers by a dot. Thus, I find in caſting up this laſt ſum it amounts to five figures; but as there are but four figures in the largeſt decimal, therefore I make a dot between the fourth and fifth figure, always keeping an equal number of decimal places.

SECTION

SECTION III.

SUBTRACTION OF DECIMALS.

Tyro. IF *Addition of Decimals* be performed like whole numbers, I imagine *Subtraction* is the ſame.

Philo. It is ſo; only place the figures to the left hand, always under one another, let them be cyphers or figures; but don't regard cyphers to the right. An example will make it quite eaſy.

From	47.0075	From	.7	From	5.25
Take	15.51	Take	.275	Take	.98407
Anſ.	31.4975	*Anſ.*	.425	*Anſ.*	4.26593
Proof	47.0075	Proof	.7	Proof	5.25

Here you ſee I do by tens, as in whole numbers, and borrow and carry the ſame, only I never ſet down cyphers to the right hand of the figures, but entirely diſcard them.

2. Borrowed 100 guineas, and paid at three ſeveral times each £. 27.275, what is to pay? *Anſ.* £. 23.175 or £. 23 - 3 - 6.

SECTION IV.

MULTIPLICATION OF DECIMALS.

Tyro. HOW is *Multiplication* performed?

Philo. Like common *Multiplication*, having no regard at all to the decimals 'till the work is done, and added up: then count how many decimal places you have both in the multiplicand and multiplier, and as many decimals as you find in both theſe, ſo many figures you are to prick, or point off from the right hand to the left: ſo will the figures on the left hand of the dot be whole numbers, and thoſe towards the left, the decimal parts.

EXAMPLES.

Multiply	7.256	Multiply	.5759
by	.762	by	.0375
	14512		28795
	43536		40313
	50792		17277
Anſ.	5.529072	*Anſ.*	.02159625*

Here in example 1, I have ſix decimals in the multiplicand and multiplier; therefore I prick or dot off ſix towards the left hand, and have 5 for a whole number, and the reſt are decimals.

* *Note*, In example 2, I have eight decimals in the multiplicand and multiplier; I find upon caſting them up, that there are but ſeven places of decimals, therefore I place a cypher before the firſt figure, and make a dot before the cypher, ſo I have eight decimal places.

This is a ſtanding rule, for had the product been leſs in the number by 2, 3, or more places, ſo many cyphers muſt have been added to ſupply the deficiency.

Tyro. This is eaſy enough, as you obſerved, to what *Vulgar Fractions* are; and I perceive that money, weight, or meaſure, may be eaſily multiplied by this rule.

Philo. You ſay right; for ſuppoſe I was to multiply £. 4 - 15*s.* by £. 3 - 10*s.* it would produce £. 16 - 12 - 6. For £. 4 - 15*s* is 4.75 (becauſe 15*s.* is ¾ of a £.) and £. 3 - 10*s.* is 3.5. Therefore £. 4.75 × 3.5 = £. 16.625, or 12*s.* 6*d.*

3. Multiply .000075 by .0015. *Anſ.* .0000001125.

4. Multiply $4\frac{1}{2}$, viz. 4.5, by 4.5. *Anſ.* 20.25, or $20\frac{1}{4}$.

5. Multiply $\frac{1}{2}$ a crown by $\frac{1}{2}$ a crown, at a ſhilling the integer. *Anſ.* 6.25, viz. 6*s.* 3*d.*

See *Multiplication of Vulgar Fractions*; and more of the nature of this, with the way and manner of valuing any decimal, in *Reduction of Decimals.*

SECTION V.

DIVISION OF DECIMALS.

Tyro. HOW is *Diviſion* performed?

Philo. The ſame as common *Diviſion*; but being a little more difficult than the other rules, you muſt be the more careful; but if you obſerve the three following notes, they will help you to work any ſum.

Note 1. When there are more decimal places in the dividend than in the diviſor, then (after the work is done) prick off as many of the quotient to ſupply that defect; that is, the decimal places of the diviſor and the quotient will always be equal in number to thoſe in the dividend.

Note 2. If there be more decimal places in the diviſor than in the dividend (before you begin to work) add as many cyphers to the dividend as make the number of decimal places equal to the diviſor, and proceed as before directed.

Note 3. When it happens that the decimal places in the diviſor and quotient (after the work is done) are not ſo many as thoſe of the dividend; then you muſt place as many cyphers before the quotient, or anſwer, as will make up that deficiency.

·5)47·3476	.12)63.00	.12).063
Anſ. 946.952	*Anſ.* 525.	*Anſ.* .00525
See Note 1.	See Note 2.	See Note 3

☞ Remember that all remainders in decimals after diviſion are of no ſignification, and therefore are taken no notice of.

The ſame is to be obſerved in long diviſion as in the three foregoing examples in relation of pointing off.

47·15)3·747565(.0794. *Anſ.*
33005

44706
42435

22715
18860

But if thus,

·4715)3·747565(7.94. *Anſ.*

Here you ſee the ſame ſum is propoſed, but the anſwer is different, as you may prove at large: for the figures will be the ſame. And thus you ſee, let them be whole or mixt numbers, the work is the ſame.

Tyro. I underſtand it: and I perceive it is very eaſy to divide money into any number of parts by this rule.

Philo. Very eaſy indeed.

6. Divide £. 42 - 19*s.* 6*d.* by £. 4 - 15*s.* 6*d.* That is, divide £. 42.975 by £. 4.775. *Anſ.*

7. Divide £. 4.5 (viz. £. 4 - 10*s.*) by £. 3.5 (viz. £. 3 - 10*s.*) *Anſ.* £. 1.285, or £. 1 - 5*s.* 8¼*d.*

8. Divide 1.753 by £. 1753. *Anſ.* 001.

This example, though it appears trifling at firſt, may be of ſervice. For ſuppoſe it was required to divide £. 1.753 among 1753 perſons, the anſwer would be .001, viz. near 1 farthing each. Thus you may vary or alter decimals at pleaſure; but as for money, and the manner of finding its value in any Decimal Fraction, that you will ſee in the next ſection, which, if you obſerve well, you will ſee the whole order of decimals, and their relation and harmony, compared with *Vulgar Fractions*.

SECTION VI.

REDUCTION OF DECIMALS.

Tyro. WHAT does *Reduction of Decimals* teach?

Philo. It teaches to reduce a vulgar fraction to a decimal of the ſame value, and alſo ſhews you how to find that value either in money, weight, or meaſure, &c.

CASE 1.

To reduce a Vulgar Fraction to a Decimal.

Add as many cyphers as you pleaſe to the numerator (making a dot between the numerator and the cyphers) then divide by the denominator as in common *Diviſion*, and making a dot before the figures in the quotient, you have the decimal equal to the vulgar fraction.

1. Reduce, $\frac{3}{4}$ to a decimal. *Anſ.* .75.

$$4)3\,00$$
$$\overline{.75}$$

Here you ſee .75 is $=\frac{3}{4}$, for 75 is $\frac{3}{4}$ of 100, its proper denominator.

2. Reduce $\frac{5}{8}$ to a decimal of the ſame value.

$$\begin{array}{r} 8)5.000 \\ \hline .625 \end{array}$$ *Anſ.*

That is, 625 is $\frac{5}{8}$ of 1000, its denominator.

3. Reduce $\frac{5}{395}$ to a decimal. *Anſ.* .01265.

4. Reduce $\frac{3}{1753}$ to a decimal. *Anſ.* .00171.

Note, Sometimes in reducing a decimal there will be a remainder; but never regard that, for if you have five places in a decimal it is ſufficient.

CASE 2.

To reduce the known Parts of Money, Weight, or Meaſure, to a Decimal.

Add cyphers to the loweſt denomination (making a dot between the cyphers and the figure) and divide by the parts contained in the next higher denomination; then place the next higher denomination before that quotient (with a dot between) and divide by the parts contained in the next higher denomination, and ſo go on, and your laſt quotient will be the decimal required. But this muſt be illuſtrated by an example, to make it plain.

1. What is the decimal of 14*s*. 6$\frac{3}{4}$*d*.

$$\begin{array}{r} 4)3.00000 \\ \hline 12)6.75000 \\ \hline 2|0)14.56250 \\ \hline .728125 \end{array}$$ *Anſ.*

Here, according to the rule, I add cyphers to the loweſt denomination, and divide by 4; then I place the 6 pence before that quotient, and divide by 12. Laſtly, I place 14 ſhillings before this laſt quotient, and divide by 20, (viz. by 2) without cutting any figure or cypher off to the right hand; for there is no occaſion for that.

See the proof of this in example 1, next caſe.

2. What is the decimal of 18*s.* 9½*d.* *Anſ.* .93958.

Note, If you would know the decimal of any number of ſhillings, from 1 to 19, obſerve this general rule: If the ſhillings be even, take the half of them is the decimal. Thus, the decimal of 16*s.* is .8, and of 18*s.* is .9, *&c.* But if the ſhillings be odd, multiply them by 5, gives the decimal. Thus the decimal of 5*s.* is .25; for 5 ſhillings is ¼ of a £. and 25 is ¼ of 100. So alſo the decimal of 17*s.* is .85, and 11*s.* is .55, and the decimal of 1*s.* is .05; for there muſt be two places when the ſhillings are odd.

A RULE *to find the Decimal of Shillings, Pence, and Farthings, at a £. Sterling the Integer, at once.*

1. For farthings. Add cyphers to the ſhillings, and divide by 20.

2. For the pence. Add cyphers to the given pence, and divide by 240, the pence in a £. pricking off according to the rule of *Diviſion.* Thus you will find the decimal of 6*d.* .025, and of 3*d.* .0125.

3. For farthings. Add cyphers, and divide by 960: thus, the decimal of 3 farthings is .003125.

Note, The ſame is to be obſerved in finding the decimal of weight and meaſure, by adding cyphers to the given denomination, and dividing by the parts contained in the integer.

To tell the Decimal of Shillings, Pence, and Farthings, by Inſpection.

Note, If the ſhillings be even, take the half of them, which will be the firſt decimal figure; then bring the pence and farthings into farthings, and if they be leſs than 25, join them to the firſt decimal figure, ſo have you a decimal of three places; but if the farthings be more than 25, ſet down one more than they really are; if they be above 40, ſet down two more than they amount to; ſo you have the decimal nearly.

1. Let it be required to find the decimal of 14*s.* 6$\frac{3}{4}$*d.* and 18*s.* 9$\frac{1}{2}$*d.* as before. Here I ſay, the $\frac{1}{2}$ of 14 is 7, the firſt figure; then 6$\frac{3}{4}$*d.* is 27 farthings, but being above 5, I ſet down 28 farthings by the ſide of the 7, ſo is the decimal .728, as before; and ſo for the other.

2. What is the decimal of 6*s.* 10$\frac{1}{2}$*d?* *Anſ.* .344.

Here the half of 6*s.* is 3, and 10$\frac{1}{2}$*d.* is 42 farthings; but being above 40, I, by the rule, ſet down 2 more, viz. 44; ſo is the decimal .344 nearly.

Note, When the ſhillings are odd, multiply them by 5, and bring the pence and farthings into farthings, as before, and ſet the firſt figure under the ſecond figure of the decimal belonging to the ſhillings, encreaſing them by 1, or 2, as before, you have the decimal.

3. What is the decimal of 17*s.* 6$\frac{3}{4}$*d.* and 11*s.* 10$\frac{3}{4}$*d?*

17 multiplied by 5 is 85	11 × 5 = .55
6$\frac{3}{4}$ more 1 farthing 28	10$\frac{3}{4}$*d.* × 4 + 2 = .045
Anſ. .878	11*s.* 10$\frac{3}{4}$*d* = .595

The next caſe is a proof to this, and more uſeful.

CASE 3.

To find the Value of a Decimal in Money, Weight, and Meaſure.

Multiply the decimal by the parts contained in the integer, and prick off as many figures as there are places in the given decimal, and the figures towards the left hand will be whole numbers, and thoſe that are pricked off are decimals, which decimals only muſt be multiplied by the next denomination; thus go on, multiplying and pricking off the ſame number of decimals; ſo will the figures towards the left hand be the value required.

1. What is the .728125 of a £. ſterling?
20

s. 14.562500
12

d. 6.7500
4

qrs. 3.00 *Anſ.* 14*s.* 6¾*d.* See Ex. 1. of laſt caſe.

2. What is the .7615 of a guinea?
21

7615
15230

s. 15.9915
12

d. 11.8980
4

qrs. 3.5920 *Anſ.* 15*s.* 11¾*d.*

3. What is the .1756 of a ton?
20

C. 3.5120
4

qrs. 2.0480
28

3840
0960

lb. 1.3440
16

oz. 5.5040 *Anſ.* 3 *C.* 2 *qrs.* 1 *lb.* 5 *oz.*

4. What is the .09715 of a barrel?

36

58290

29145

gallons 3.49740

8

pints 3.97920

Anſ. 3. *gall.* 3 *pints*, and $\frac{9}{10}$, or very near $3\frac{1}{2}$ *gallons.*

To tell the Value of any Decimal in Shillings, Pence, and Farthings, (by Inſpection only) at a £. Sterling the Integer.

Note, If there be ever ſo many places in the decimal, the firſt three figures are ſufficient, and all that are required in buſineſs.

Note 2. Double the firſt decimal place towards the left hand, and if the ſecond figure be under 5, then the firſt figure only doubled will be the ſhillings; but if the ſecond figure be 5, or above 5, then you muſt add one ſhilling more to thoſe you doubled; and what remains from the ſecond figure above 5, carry to the next figure, and reckon them as ſo many farthings; and if above 25, account them ſtill as farthings, only abate 1; but if above 40, then abate two farthings leſs then they really are, and you have the value required.

1. What is the value of .728125 of a £. *Anſ.* 14*s.* $6\frac{3}{4}$*d.*

Here I double the firſt figure 7, which is 14, for the ſhillings, and then I ſay, 28 farthings is 7*d.* but I abate 1 becauſe it is above .25; ſo it is 14*s.* $6\frac{3}{4}$*d.*

2. What is the value of .39525 of a £? *Anſ.* 7*s.* $10\frac{3}{4}$*d.*

Here I ſay, twice 3 is 6, and the next figure being above 5, I count 1 more, which is 7 ſhillings; then there is 4 remains from the 9, which I carry to the 5, which is 45 farthings; but being above 40, I abate 2, and call it 43 farthings, which is 10¾*d.*

3. What is the .0672 of a £. ſterling? *Anſ.* 1*s.* 4*d.*

Here the cyphers doubled is 0; but the ſecond figure being 6, that is 1 ſhilling and 1 over, which I carry to the 7, is 17 farthings, and abating 1 farthing is 16, or 4 pence; which you may prove by multiplying the decimal by 20, 12, and 4, pricking off as before directed.

EXAMPLES *for Exerciſe.*

4. What is .8145 of a ton? *Anſ.* 16 *C.* 1 *qr.* 4 *lb.* 7 *oz.* 10 *dwts.* .88.

5. What is the .275 of a *lb.* troy? *Anſ.* 3 *oz.* 6 *dwts.*

6. What is the .0729 of a year, at 365 days the integer? *Anſ.* 26 *days*, 14 *hours*, 36 *minutes*, 14 *ſeconds.*

Theſe examples are ſufficient for any diligent learner, therefore I will proceed to put them all in practice.

SECTION VII.

The RULE OF THREE DIRECT IN DECIMAL FRACTIONS.

Tyro. HOW is the *Rule of Three* in *Decimals* performed?

Philo. The ſame as in the *common Rule of Three Direct*, by multiplying the ſecond number by the third, and dividing by the firſt.

1. If $\frac{3}{4}$ of a yard coſt $\frac{5}{6}$ of a £. what coſt 51$\frac{1}{4}$ yards; that is, if 3 qrs. coſt 16*s.* 8*d.* what coſt 51 yards, 1 qr?

Decimally thus,

If .75 be .8333, what is 51.25 yards?

Here multiply your ſecond by the third, and divide by the firſt, you have the quotient 56.942, viz. £. 56 - 18*s.* 10*d.*

See example 1, *Rule of Three of Vulgar Fractions.*

2. If a buſhel of wheat coſt 3*s.* 9$\frac{1}{2}$*d.* what coſt 40 buſhels, or 1 load? *Anſ.* £. 7-11-8.

Decimally thus,

If a buſhel of wheat coſt .18958, what coſt 40?
40

£. 7.58320 *Anſ.* £. 7-11*s.* 8*d.*

Tyro. This laſt example is very ſhort indeed.

Philo. It will always be ſo when the firſt number is 1, or unity; for decimals are ſuperior to vulgar fractions for eaſe and expedition; and though not always ſo near the truth itſelf, yet anſwer every thing near enough for any buſineſs or demand. See the next queſtion in variations.

3. If 5$\frac{1}{4}$ ells coſt £. 2$\frac{803}{960}$ of a £. what coſt 282$\frac{1}{2}$ ells; that is, if 5$\frac{1}{4}$ coſt £. 2-16*s.* 8$\frac{3}{4}$*d.* what coſt 282$\frac{1}{2}$ ells?

Decimally thus,

If 5.25 ells coſt £. 2.8364, what coſt 282.5 ells? *Anſ.* £. 152.625, viz. £. 152 - 12 - 6.

4. If a ton of ſweet oil coſt £. 24-17-4$\frac{1}{2}$, what coſt 14 *T.* 17 *C.* 2 *qrs.* 19 *lb*? *Anſ.* £. 370.1335, or 2*s.* 8*d.*

Now, *Tyro*, in all ſuch ſums as theſe, which either by the *Rule of Three*, *Practice*, or *Vulgar Fractions*, will become very tedious; yet by finding the decimal of the odd weight, and the odd price, you have only a common multiplication ſum.

That is, multiply 14 ton .88348 by £. 24.86875, you will have £. 370.1335, viz. 2*s*. 8*d*. *Anſ*.

Note, You may find the decimal of 17 *C*. 2 *qrs*. 19 *lb*. by bringing them into *lbs*. and dividing by the *lbs*. in a ton, viz. 2240. The ſame for any other weight or meaſure, by reducing the parts, and dividing by the parts contained in the integer.

DIALOGUE XIV.

SECTION I.

SIMPLE INTEREST.

Tyro. HOW is *Simple Intereſt* in *Decimals* performed?

Philo. Very eaſy, by the following rule.

Multiply the principal by the rate per cent. and prick off the decimals, gives the intereſt for one year; and if there be odd time, take the parts of the principal itſelf, and add to the work, it is done.

Note, For £. 4 per cent. multiply by .04; for 5 per cent. by .05; for 6 per cent. .06; for 7 per cent. .07.

1. What is the intereſt of £. 147-15*s*. for a year, at £. 4 per cent. per annum? *Anſ*. £. 5 - 18 - 2¼.

£. 147·75
.04

£. 5).9100
20

s. 18)20
12

d. 2)40
4

q. 1)60

2. What is the intereſt of £. 275 - 10*s.* for 1 year, at £. 6 per cent?

£. 275.5
.06

£. 16 530

Anſ. £. 16 - 10 - 7¼.

And the work will be as eaſy, if the per cent. be for odd time, as appears by the following examples.

3. What is the intereſt of £. 1250 - 15*s.* for 3½ years, at 6 per cent. per annum?

£. 1250.75
.06

75.0450 for 1 year.
½ 3

225.1350 for three years
37.5225 add for the ½ year

262.6575 for 3½ years. *Anſ.*

4. A perſon left his wife by will ⅓ of his eſtate, which was £. 355 - 7 - 6. Now this lay in hand 3½ years; I demand what intereſt is due upon it, at £. 4½ per cent. per annum? *Anſ.* £. 55 - 19 - 5.

Multiply £. 355.375 by £. 4½, that is by .045, is £. 15.991875 for 1 year: this multiplied by 3.5 years, gives £. 55.9715625.

And thus you ſee, that if the principal, intereſt, or time, be ever ſo much, yet it is eaſily performed by decimals.

5. A merchant made an aſſurance upon goods in a ſhip bound to a certain port, to the value of £. 2530,

upon condition, that in caſe of a total loſs or damage, the aſſurers were to pay £. 97½ per cent. deducting ½ per cent. (viz. 10*s.* per cent.) out of it: now the ſhip was caſt away, but there were as many goods ſaved as amounted to £. 955; I demand what the merchant has to receive? *Anſ.* £. 1527 - 18 - 11.

Firſt, £. 955 taken from £. 2530 remains £. 1575 loſs: this multiplied by 97.5 is 1535.625, and deducting ½ per cent. from this, is only cutting off two figures in the pounds, thus, 15|35, and take the ½ of 15|35.625 which is 7.678125, placing it in the units place of the pounds, and the reſt in order (as follows in diviſion) and ſubtract it from £. 1535.625, leaves £. 1527.946875, viz. 18*s.* 11*d.* *Anſ.*

The proof of this is worthy your obſervation, *Tyro:* For, obſerve, 97½ per cent. wants but 2½ per cent. of £. 100, that is, of being cent. per cent. Now if you multiply £. 1575 by 2.5, (viz. 2½) it gives £. 39.375, which added to £. 1535.625, gives the original ſum or loſs, viz. £. 1575.

Tyro. I thank you kindly, ſir; for this, as you have obſerved, is a proof to me very plainly.

6. What comes an aſſurance, or a commiſſion, factorage, or brokerage to, upon £. 3500, at 18*s.* per cent.

35|00
.9 the decimal of 18*s.*

£. 31.5 *Anſ.* £. 31 - 10.

And thus decimals perform any thing with eaſe and pleaſure.

Tyro. I ſee it, ſir; and now be pleaſed to give me an example or two in *Compound Intereſt.*

Philo. I will.

SECTION

SECTION II.

COMPOUND INTEREST.

Tyro. HOW is *Compound Intereſt* performed?

Philo. By continual Multiplication and Addition.

Queſt. 1. What will £. 100 amount to, if it be forborne 5 years at 5 per cent. per annum, Compound Intereſt. *Anſ.* £. 127 - 12 - $6\frac{3}{4}$

1. The common method is to multiply the principal by the per cent. and cut off two figures, (which is the ſame as dividing by 100) this gives the intereſt for one year, which is £. 5; this add to £. 100, gives £. 105 for the amount of the firſt year. Then this multiplied by the per cent. gives the intereſt for the 2d year, which added to the principal of £. 105, gives £. 110.25 for the amount of the 2d year, &c. &c. But this is tedious; therefore the beſt way is,

2. Set down the principal 100l. and find the intereſt the 1ſt year, and add it to it, and it makes as before 105. Set the 5 under the 100l. and make two dots, after it, thus, 5 . . this ſaves dividing by 100, and will ſupply the decimal places; then multiply 105l. by 5, (viz. 05 in decimals) keeping always 2 figures of the decimals under the two dots, and it produces 5——25, which, added to 105l. gives 110.25l. as before, &c. &c. See the operation.

£. 100 × viz. by .05 is 5.00, viz. 5
5 . . added
Amount
1 year 105 . . this × .05
is 5.25 add

2 year 110.25 this × .05
is 5.5125 add

3 year 115.7625 this × .05
is 5.7881 add

4 year 121.5506 this × .05
is 6.0775

5 year 127.6281 *Anſ.* £. 127.12.

Queſt. 2. *A* lent *B* £. 136.775, which *B* promiſed to pay compound intereſt for, at £. 6 per cent. per annum, and bound his heirs, executors, &c. to that condition: Now *A* died, and *B* took no notice of payment 'till it was at laſt diſcovered by the executors of *A*, and *B* had had the money in hand 20 years: I demand what *B* has got to remit for the debt? *Anſ.* £. 438.651.

But the ſhorteſt method of all to calculate compound intereſt, is by the following tables:

TABLE I.

A Table ſhewing how much 1 Pound ſterling will amount to in any Number of Years under 21, at £. 5 per Cent. per Annum, Compound Intereſt.

Years.	£. 5 *per cent.*	*Years.*	£. 5 *per cent.*
1	1.05	11	1.7103
2	1.1025	12	1.7958
3	1.15763	13	1.8856
4	1.2155	14	1.9799
5	1.27628	15	2.079
6	1.3401	16	2.1828
7	1 4071	17	2.292
8	1.4744	18	2.4066
9	1.5513	19	2.5269
10	1.6289	20	2.6533

TABLE II.

A Table ſhewing how much 1 Pound ſterling will amount to in any Number of Years under 21, at the rate of £. 6 per Cent. per Ann. Compound Intereſt.

Years.	£. 6 *per cent.*	*Years.*	£. 6 *per cent.*
1	1.06	11	1.8982
2	1.1236	12	2.0121
3	1.191	13	2.1329
4	1.2624	14	2.261
5	1.3382	15	2.3965
6	1.4185	16	2.5403
7	1.5036	17	2.6927
8	1.5938	18	2.8543
9	1.6894	19	3.0256
10	1.7908	20	3.2071

1. The Explanation of the Tables.

The amount of £. 1 for 1 year, at £. 5 per cent. is 1.05; this ×105=1.1025, the amount of the 2d year; this ×1.05 is 1.1576, &c. &c. The ſame for £. 6 per cent. which is 1.06, this into 1.06 is equal to 1.1236 for the ſecond year, &c. &c.

2. The Uſe of the Tables.

When any ſum is given for any number of years, then multiply the given ſum by the number given right againſt, or anſwering to the number of years, and you have the anſwer at one operation.

Let us take example 1, viz. £. 100, for 5 years, at £. 5 per cent.

I look in the table of 5 per cent. and againſt 5 years I find 1.27628 (the amount of £. 1 for 5 years) this multiplied by £. 100 gives 127.628, viz. £. 127-12-6¾ as before.

Tyro. This is ſhort indeed!

Philo. 'Tis the ſame at if it were for 20 years. Thus in example 2, it is required to tell the amount of £. 136-15-6, for 20 years, at £. 6 per cent. compound intereſt.

I look in the table for £. 6 per cent. and againſt 20 years I find 3.2071, the amount of £. 1 for that time; this multiplied by the ſum £. 136-15-6, (viz. 136.775) gives £. 438.651, viz. £. 436.13 ſhillings and 1 farthing.

Tyro. I like this very well; but ſuppoſe the years are more than in the tables, how then?

Philo. Very eaſy; only add any two or more numbers together, as make the number, and multiply the ſums belonging to each number of years in the table together, gives the right ſum for that number of years.

Thus, ſuppoſe I wanted to tell the amount of the laſt queſtion for 30 years, at £. 6 per cent. Here I take any two numbers, which added, make 30. Suppoſe for example 10 and 20; againſt 10 I find 1.7908, and againſt 20 I find 3.2071, this multiplied together gives 5.7432, the amount of £. 1 for 30 years, at £. 6 per cent. which multiplied into £. 136.775, gives 785.526, the amount of this ſum for 30 years; and thus for any other numbers.

Tyro. I heartily thank you, ſir.

Philo. You ſee how eaſy it is, and this is the only method to calculate annuities, penſions, &c. except you can do it by *Algebraic* calculation.

Note, Theſe tables are eaſily made; the conſtruction depends, as I told you, in *Simple Intereſt*, upon this; That let the per cent. be what it will, ſuppoſe £. 4 per cent. ſay, if £. 100 be 104, what will £. 1 be? *Anſ.* £. 1.04 for 1 year. So alſo for $4\frac{1}{2}$ per cent. it is £. 1.045; for 5, it is £. 1.05, &c.

Tyro. I underſtand you very well, ſir, and ſhall endeavour, as time offers itſelf conveniently, to look over theſe things, and make myſelf yet more perfect.

Philo. You will perform your promiſe, I hope; but before I leave you, I will give you a notion of the Extraction of the *Square* and *Cube Roots*, being very neceſſary in many buſineſſes, but eſpecially in the art of menſuration, and ſeveral other branches of the mathematics.

DIALOGUE XV.

SECTION I.

The EXTRACTION *of the* SQUARE ROOT.

Tyro. WHAT do you mean by the words *Square* and *Root?*

Philo. A ſquare number is a number multiplied by itſelf, viz. any figure or figures multiplied by the ſame figure or figures, the product is the ſquare of that number: Thus, 2×2=4, the ſquare of 2; and 9×9=81, the ſquare of 9.

Tyro. This is plain enough. And what is the *Root* then?

Philo. The root is that from which the ſquare is formed: Thus, I told you before, the ſquare of 2 is 4, and the ſquare of 9, is 81; therefore, *vice verſa*, 2 is the root of 4, and 9 is the root of 81, as appears by the following table, which ſhould be readily known.

TABLE.

Roots	1	2	3	4	5	6	7	8	9	10	11	12
Squares	1	4	9	16	25	36	49	64	81	100	121	144

Tyro. How is the *ſquare Root* extracted?

Philo. I will ſhew you the whole proceſs, which pray obſerve.

Suppoſe it were required to extract the *ſquare Root* of 3136, or any other figures.

Firſt, I ſet down the figures thus $3\dot{1}3\dot{6}$, and beginning at the units place, I make a dot or point over it, and alſo over every other figure towards the left hand, as you ſee in the margin; and pray obſerve that as many dots as you have, ſo many figures the *Root* will always conſiſt of, which here are 2.

Secondly, I ſeek (by the table) the neareſt root to the figures contained in the firſt point of figures, viz. in

31, and find it to be 5, which I place in the quotient, thus, 3136(5, which figure 5 is called the root or part of the root.

Thirdly, Square the root, that is, multiply it by itſelf, and place it under the ſaid firſt points as in common *Diviſion*, and ſubtract it therefrom, and bring down the next point, viz. 36, and place it by the ſide of the remainder, it is 636, which is called the reſolvend, as in the margin.

3136(5
25
——
636 *reſolvend.*

Fourthly, Then I double the quotient figure or root 5, which is 10, and making another crooked line, I place it for a diviſor right againſt the reſolvend, thus,

3136(5
25
——
Diviſor 10)636 *reſolvend.*

Fifthly, I now aſk (as in *Diviſion)* how many times 10 I can have in the reſolvend (always rejecting the laſt figure) that is, how many times 10 are contained in 63, and find it 6 times, which 6 I put in the root by the ſide of the 5, and alſo by the ſide of the diviſor 10, which makes 106; then I multiply 106 by 6, which is 636, and nothing remains; thus I find the ſquare root of 3136 to be 56.

3136(56 root. *Anſ.*
25
——
106(636
636

PROOF.

I ſquare the root of 56, that is, I multiply it by itſelf, viz. 56 by 56, and it gives 3136.

2. What is the ſquare root of 56169?

56169(237 root *Anſ.*
4
——
43)161 reſolvend
129
——
467)3269 new reſolvend
3269
——
0

Here I proceed the ſame as in example 1, by making a dot over every other figure, and find the neareſt the root of the firſt point 5 to be 2, which I ſquare, and place under 5, and remains 1, to which I bring down the next two figures 61, and it is 161; then I double the root 2, it is 4, which I place on the left hand for a diviſor. Then I aſk how many times 4 are contained in 16, which though it be 4, yet upon trial will be but 3 times (for you muſt obſerve, it will often be leſs than it looks to be) which 3 I place in the quotient, and alſo by the ſide of the diviſor 4, which makes it 43; then I multiply 43 by 3, and it is 129; and ſubtracting 129 from 161, I have 32 remains, to which I bring down the next point, or two figures 69, and it is 3269, which I call a new reſolvend; then I double the root 23, which is 46 for a new diviſor, and aſk how many times 46 I can have in 326, and find it 7, which I place in the quotient, and alſo after 46, and it is 467, which multiplied by 7, gives 3269. Thus I find the *Square Root* of 56169 to be 237. And for a proof I find 237 multiplied by 237=56169. Do you underſtand it, *Tyro?*

Tyro. Very well, ſir: then I perceive that after I have done with the firſt figure in the root, I am to double it, and take down the next point, and then double the two figures, and take down the next point, and ſo keep on in the ſame order, am I not?

Philo. Your notion is right, and if you conſider well the manner of the working the laſt example, if you have ever ſo many figures, you may do it with eaſe.

Tyro. But ſuppoſe after the work there ſhould be a remainder?

Philo. That matters not at all; only when you come to prove the work, after multiplying the root by itſelf, you muſt add the remainder to the product, and it will be equal to the given number, if the work be right.

Sums for Practice.

3. I demand the ſquare root of 2996361. *Anſ.* 1731.
4. I demand the ſquare root of 3076516. *Anſ.* 1754.
5. What is the ſquare root of 43623. *Anſ.* 208, and 359 remains over.

N. B. If you have a mind at any time to know what the remainder will produce, add an even number of cyphers to the ſum, and double the root, and proceed as before: thus, the ſquare root of 43623,000000 is 208,861.

2. To extract the ſquare root of a vulgar fraction: Extract the ſquare root of the numerator for a new numerator, and of the denominator for a new denominator.

6. What is the ſquare root of $\frac{25}{81}$? *Anſ.* $\frac{5}{9}$.

Note, When you cannot extract the root of the numerator and denominator, then reduce the vulgar fraction to a decimal, and extract the ſquare root, you have the anſwer.

7. What is the ſquare root of 1 and $\frac{3}{5}$?

Firſt, $\frac{3}{5}$ is = 6, which is 1.6; then I add cyphers, thus, 1.600000, and find the root to be 1.265.

Note, There muſt always be an equal number of decimals.

8. What is the ſquare root of 19.2? *Anſ.* 4.3817.

9. What is the ſquare root of .0003? *Anſ.* .01732.

SECTION II.

The Uſe of the SQUARE ROOT, *applied to various Branches of the* Mathematics.

10. I Demand what is the mean proportional number between 30 and 50. *Anſ.* 38.7 tenths.

Multiply one number by the other, and add cyphers and extract the ſquare root, you have 38.7.

11. There is a triangle, whoſe baſe is 30 inches, and the perpendicular 40; I demand the hypothenuſe? *Anſ.* 50.

Note, The perpendicular is that part which is right up; the baſe is that which lies next you, and the hypothenuſe is the ſlanting ſide, called alſo the diagonal line.

A general Rule to find the third Side of any Triangle, having two Sides given.

1. Having the perpendicular 40, and baſe 30, as above, to find the hypothenuſe, add the ſquare of the baſe and perpendicular together, and extract the ſquare

root of them, you have the hypothenuſe. Thus, the ſquare of 30=900. The ſquare of 40=1600, their ſum is 2500, the ſquare root of which is 50, the hypothenuſe required.

2. Having the hypothenuſe and perpendicular, or baſe, given, to find the other ſide.

From the ſquare of the hypothenuſe take the ſquare of the baſe, or perpendicular, and the ſquare root is the other ſide required.

EXAMPLES.

12. There is a ſteeple to whoſe vane or top a ſtring is tied, which reaching to the ground, is in length 60 yards, and the diſtance from where it touches the ground to the middle of the ſteeple end is 25 yards; I demand the height of the ſteeple? *Anſ.* 54.5 yards.

Square 60 is 3600, and take the ſquare of 25, viz. 625, from it, and extract the ſquare root, you have 54.5.

13. Suppoſe a ſhip ſails from a certain port, has made 87 miles difference of latitude, and 71 miles departure, what is her diſtance on a regular courſe? This is only finding the hopothenuſe; for add the ſquare of 87 and 71 together, and extract the ſquare root, you have 112.2 miles diſtance.

14. There is a circle or triangle, whoſe ſuperficial content is 30800.25, I demand the ſide of a ſquare, whoſe ſuperficial content ſhall be equal thereto? *Anſ.* 175.5.

15. Suppoſe a rope 5 inches round, I demand the compaſs of another rope, that is double the ſtrength? Square the compaſs of the rope, it is 25, which multiply by 2, and extract the ſquare root, it is 7.07 inches. If it were required to be 3, 4, 5, or 6 times the ſtrength, then multiply the ſquare by 2, 3, 4, 5, or 6, and extract the root.

16. There is a cable 10 inches round, which weighs 21 *C.* I demand the weight of one 8 inches round? *Anſ.* 13.44 *C.*

As the ſquare of the one, viz. 100, is to the ſquare of the other, viz. 64, ſo is the weight of the one to the other, viz. 13.44 *C.*

17. There is a circle whoſe content is 153.9385, I demand its diameter.

Firſt, As 22 is to 28 :: 153.9385 to the ſquare of the diameter, viz. 195.9217, whoſe ſquare root is 13.99.

And thus I think I have given you ſufficient examples in this rule, that you may with a little more practice become quite maſter of it.

Tyro. I thank you for your care, ſir, and I underſtand it very well; I wiſh I underſtood the *Cube Root* as well.

Philo. That you may ſoon do by care, and a little more pains, though it be ſomething more difficult than this rule.

DIALOGUE XVI.

SECTION I.

The EXTRACTION *of the* CUBE ROOT.

Tyro. WHAT do you mean by a cube?

Philo. A cube is that which has length, breadth, and thickneſs: thus, ſuppoſe a piece of wood to be cut into the form of a die, which is equal every way, in length, breadth, and thichneſs, ſuch a figure is called a ſolid, and by name a cube.

Tyro. Give me a further deſcription of a cube in figures.

Philo. You know any number multiplied by itſelf is a ſquare; ſo any number multiplied twice by itſelf is a cube number; thus the cube of 2 is 8: for 2×2 is 4, and 4×2=8: ſo alſo, the cube of 5 is 125: for 5×5×5=125. Thus you ſee 8 is the cube, and 2 the root of that cube; alſo 125 is a cube number, whoſe root is 5, as appears by the following table of both ſquares and cubes.

TABLE.

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81
Cubes	1	8	27	64	125	216	343	512	729

Tyro. How is the cube root extracted?

Philo. To give you a rule for it (I look upon) would be too tireſome for your memory, as there are many parts contained in it: I ſhall therefore take an example or two, and proceed in the whole proceſs, or order of the work.

1. I demand the cube root of 32768? *Anſ.* 32.

RULE 1.

Firſt, I make a dot over every fourth figure, beginning at the units place, as in the margin, and as many dots as you have, ſo many places the root will contain, which here are two places, $3\dot{2}76\dot{8}$.

Secondly, Seek the root, or neareſt root, to the firſt point 32, which (by the table) is 3, and place it in the quotient, which is the firſt figure in the root, thus, 32768(3.

Thirdly, Cube the figure which you put in the quotient (that is, $3\times3\times3=27$) and place it under the firſt point 32, and ſubtract it therefrom, Thus,

$$\begin{array}{l} 32768(3 \\ 27 \\ \hline \ \ 5 \end{array}$$

Fourthly, To this remainder (5) bring down all the figures of the next point, (viz. 768) and place them by the ſide of the remainder, and call this the reſolvend, Thus,

$$\begin{array}{l} 32768(3 \\ 27 \\ \hline 5768 \text{ reſolvend} \end{array}$$

Fifthly, Triple the quotient, (that is, always multiply it by 3) and put the units place to it under the tens place of the reſolvend; and call that the triple quotient, Thus,

$$\begin{array}{l} 32768(3 \\ 27 \\ \hline 5768 \text{ reſolvend} \\ \ \ \ 9 \text{ triple quotient} \end{array}$$

Sixthly, Now ſquare the quotient (that is 9) and triple that ſquare, that is 27, and place the units place of it under the tens place of the triple quotient; that is, place it one figure more to the left hand, and call it the triple ſquare, Thus,

Seventhly, Add theſe two together, and call it the diviſor, Thus,

$$\begin{array}{l} 32768(3 \\ 27 \\ \hline 5768 \text{ reſolvend} \\ \hline \ \ \ 9 \text{ triple quotient} \\ 27 \text{ triple ſquare} \\ \hline 279 \text{ diviſor} \end{array}$$

Eighthly, Aſk how many times the diviſor is contained in the reſolvend, rejecting the laſt figure as you did in the ſquare root; that is, aſk how many times 279 you can have in 576 the reſolvend, which here is 2, and place this alſo in the quotient, which now is 32,

Thus,

32768(32
27

5768

9 triple quotient
27 triple ſquare

279 diviſor

Ninthly, Cube the figure laſt put in the quotient, (viz. 2, whoſe cube is 8) and place the units place under the units place of the reſolvend.

32768(32 root
27

5768 reſolvend

9 triple quotient
27 triple ſquare

279 diviſor

8 cube of 2

Tenthly, Multiply the ſquare of the figure laſt put in the quotient (viz. 4) into the triple quotient, (viz. ×9) which is 36, and place the product one figure more towards the left hand.

32768(32 root
27

5768 reſolvend

9 triple quotient
27 triple ſquare

279 diviſor

8 cube of 2
36 the ſquare of 2
by trip. quot.

Eleventhly, Multiply the triple ſquare (viz. 27) by the laſt figure put in the quotient, and place alſo this, one figure more towards the left hand, which is 54.

32768(32 root. *Anſ.*
27

5768 reſolvend

9 triple quotient
27 triple ſquare

279 diviſor

Twelfth, Add theſe three laſt numbers together as they ſtand, and call it the ſubtrahend which is 5768, equal to the reſolvend.

8 cube of 2
36 ſq. of 2 by tr. qu.
54 tr. ſquare by the root 2

5768 ſubtrahend

Thus is the work finiſhed, and the cube root of 32768 is found to be 32.

PROOF.

For the proof of this, multiply 32 by 32, and it is 1024, which 1024 I multiply by 32 again, and have 32768.

Note 1. If the ſubtrahend had been larger than the reſolvend, then I muſt put a leſs figure in the ſecond place in the quotient, and proceed as before directed.

Note 2. When there is another point of figures to take down, firſt ſubtract the ſubtrahend from the reſolvend, and to the remainder bring down the next point, calling it the new reſolvend, or ſecond reſolvend; then proceed to work as after the firſt reſolvend in every reſpect.

2. Another method to extract the cube root, which is in many reſpects eaſier and ſhorter than the former.

Let us take the laſt example 32768.

Firſt, Find the root of the firſt point as before, and ſubtract it therefrom, and to the remainder bring down the next point of figures, and call it reſolvend, or dividend, which you pleaſe.

Secondly, Square the root, and multiply it by 300 for a diviſor; and, as in common *Diviſion*, ſee how many times it is contained in the dividend, and place it in the quotient, or root accordingly.

Thirdly, Multiply the diviſor by the laſt figure of the root, and place it under the dividend (units under units) drawing a line between them.

Fourthly, Square the laſt quotient figure, and multiply it by the firſt quotient figure, and that product multiply by 30, and ſet this under the laſt work, units under units, *&c.*

Fifthly, Cube the laſt figure, and put the units of this under the units of the laſt, and add theſe three together, in order as they ſtand, which is the ſubtrahend; which if it be more than the reſolvend, or dividend, you muſt put a leſs figure in the quotient, and proceed as before; but if it be leſs than the dividend, ſubtract it therefrom, and the work is done, for two figures in the root: But if there be more figures, bring them down to the remainder, and call it a new dividend; and ſquare the whole root, and multiply by 300, for a new diviſor, and put the figures in the quotient. Then ſquare this laſt figure, and multiply it by the foregoing figures in the root, and then by 30.

Laſtly, Cube the laſt figure, and place it as before directed, and the work is done for three places. The ſame to be obſerved for more figures.

Thus, the laſt example 32768(32 root. *Anſ.*
27

Diviſor 2700) 5768 dividend

5400
360
8

5768 ſubtrahend.

Tyro. I underſtand it very well, and think this laſt way the eaſieſt.

Philo. Take your choice, as I obſerved before; I ſhall now only ſet you one ſum at large, the firſt way, which you may prove by the ſecond.

2. What is the cube root of 12812904? *Anſ.* 234.

12812904(234 root. *Anſ.*
8

4812 reſolvend

6 triple quotient.
12 triple ſquare

126 diviſor

27 cube of 3
54 ſquare of 3 by T. quotient
36 triple ſquare by the root 3

4167 ſubtrahend

645904 new reſolvend

69 triple quotient
1587 triple ſquare

15939 new diviſor

64 cubic of 4
1104 ſquare of 4 by T. quotient
6348 triple ſquare by the root 4

645904 new ſubtrahend = new reſolvend.

This you may eaſily prove the other way at leiſure. Alſo 234 × 234 × 234 = 12812904.

QUESTIONS *for Practice.*

3. What is the cube root of 5396209064? *Anſ.* 1754.

4. I demand the cube root of 9423479350146861? *Anſ.* 211221.

To

To extract the Cube Root of any Vulgar or Decimal Fractions.

5. What is the cube root of $\frac{27}{1331}$? *Anſ.* $\frac{3}{11}$.

6. What is the cube root of $\frac{2197}{9261}$? *Anſ.* $\frac{13}{21}$.

Extract the cube root of the numerator and denominator for a new numerator and denominator.

7. Extract the cube root of 32.768. *Anſ.* 3.2.

Proceed as in whole numbers, only prick off as many decimals in the root as you have dots over the decimals.

Note, As in the ſquare root you add either 2, 4, 6, *&c.* cyphers to the decimal, ſo here you muſt add by three's, that is, you muſt add either 3, 6, or 9, *&c.* cyphers.

8. What is the cube root of .002? *Anſ.* .1259, and 4383021 remains.

SECTION II.

The USE *of the* CUBE ROOT.

9. THERE is a cube whoſe ſolidity is 1372 feet, I demand the ſide of a cube, whoſe ſolidity is four times leſs? *Anſ.* 7.

Divide 1372 by 4, and extract the cube root.

10. If a bullet two inches diameter weighs 3*lb.* what will one of the ſame metal weigh which is eight inches diameter? *Anſ.* 192*lb.*

11. Solids being in the triple proportion to their ſides or diameter, it is thus found:

As the cube of the given diameter is to the weight, ſo is the cube of the other diameter to the weight of the other required.

12. Suppoſe a ſhot of four inches diameter weighs 18 *lb.* I demand the diameter of another that weighs 144 *lb.* *Anſ.* 8 inches. This is the reverſe of the laſt queſtion.

13. There is a ſphere or globe, whoſe ſolid content is 250047 inches: I demand the ſide of a cube, whoſe ſolidity ſhall be equal to the ſolidity of the globe. *Anſ.* 63 inches.

14. A country farmer lent his neighbour out of his hay-ſtack 20 feet of hay, in length, breadth, and depth, and his neighbour brought it home 10 feet at one time, and ten at another: how is the balance, and who debtor? *Anſ.* 6000 feet due to him that lent it: he having received but $\frac{1}{4}$th.

15. Suppoſe a ſhip 300 tons burthen, 75 feet by the keel, 29$\frac{1}{2}$ feet by the beam, and 14 feet deep in the hold; I demand the dimenſions of another ſhip of the ſame make, of 500 tons burthen?

Say, as 300 tons is to 500 tons, ſo is the cube of the given keel to the cube of the ſhip's keel required, the cube root of which is 88.9 feet, *Anſ.*

And thus for the other two dimenſions, which I leave for your practice.

And now, *Tyro*, before I leave you, I will give you a little hint of meaſuring, gauging, &c. which may poſſibly be of ſervice to you, and your acquaintance. You muſt expect me to be very ſhort; but you may, by your care and diligence, make a better progreſs.

POST-

POSTSCRIPT.

DIALOGUE XVII.

AS this little Treatiſe may fall into the hands of ſuch perſons in the country, who would be glad of an opportunity of having a notion of meaſuring a piece of timber, a brick wall, a ciſtern of malt, or a common regular field, or piece of land, *&c.* I have (on purpoſe for their amuſement, and inſtruction of thoſe youths that have a fancy this way) added this *Poſtſcript*, which I make no doubt will be very acceptable to all ſuch as delight to be induſtriouſly employed at leiſure times: and I perſuade myſelf, it muſt be very agreeable to a parent, in either of theſe ways of life, to ſee his ſon diligent and ready at theſe things; which though he may not meaſure ſo exact for want of more learning, proper inſtruments, or experience, yet may come near enough the truth to give ſatisfaction.

Of FLOORING, ROOFING, *&c.*

Queſt. 1. How many clinkers, 6 inches long, and 3 inches wide, will floor a ſtable 17 feet long, and 9 feet wide? *Anſ.* 1224.

Multiply the length of the ſtable by the breadth, gives 153 feet; this multiply by 144, the ſquare inches in a ſquare foot, gives 22032 inches; this divide by 18, the inches in 1 clinker, gives 1224, *Anſ.*

Queſt. 2. How many oak planks will floor a barn 60½ feet long, and 33½ feet wide, when the planks are 15 feet long, and 15 inches wide? *Anſ.* 108.

Multiply 60.5×33.5=2026.75. Then 15 feet × 1.25 feet (viz. 15 inches) gives 18.75 feet for 1 plank; now 2026.75÷18.75, gives 108 planks.

Queſt. 3. A thatcher thatches a barn 60 feet long, and 25 feet wide, and the two porches are each 15 feet long, and 10 feet deep, I demand how many ſquares are contained in it? *Anſ.* 33 ſquares. *N. B.* 100 feet is 1 ſquare.

Multiply 60 by 25 gives 1500 feet for 1 ſide, which doubled, gives 3000 for both the ſides; then the porch, viz. 15×10, gives 150 for 1 ſide, which doubled, gives 300, which added to 3000 is 3300, which divided by 100 (that is, cutting off two figures) gives 33 ſquares.

2. *Of* PAVING, PAINTING, WAINSCOTING, *&c.*

Tyro. How is paving, painting, and wainſcoting meaſured?

Philo. By the ſquare yard; 9 ſquare feet being one yard.

Queſt. 4. A gentleman has a walk 22 yards long, and 12 feet wide, which is paved of ſtone; how many yards does it contain? *Anſ.* 88 yards.

Firſt, Multiply 22 yards, viz. 66 feet, by 12, gives 792, which divide by 9, gives 88 yards.

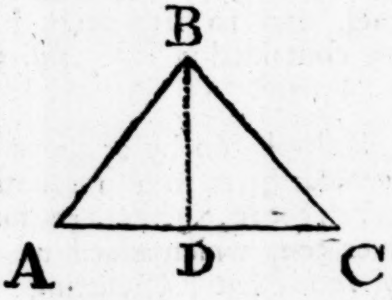
Queſt. 5. There is a room 64 feet round, and 9 feet high, in which are two windows, each 6 feet high, and 3 feet wide, and the fire-place contains 9 ſquare feet; I demand how many yards of paper, half-yard wide, will hang it? *Anſ.* 118 yards.

Firſt, 64×9=576 yards, the content, out of which take 18 feet each window, viz. 36 feet, and 9 the fire-place, is 45; and the remainder is 531 feet, which divide by 9, gives 59 yards, the content of the room; but as the paper is ½ yard wide only, it will take double this number, viz. 118 yards, *Anſ.*

Painting, Wainſcoting, *&c.* are done by the yard ſquare, and meaſured after this manner.

To meaſure the Peak End of a Houſe, or any Triangle.

Queſt. 6. Let *A B C* be the peak end of a roof, whoſe baſe *A C* meaſures 24 feet, and the perpendicular line *B D* from the top of the peak 16, I demand how many ſquare yards it contains?



Multiply $\frac{1}{2}$ the perpendicular *B D* by the whole baſe or line *A C*; or elſe, multiply the whole perpendicular *B D* by $\frac{1}{2}$ the baſe *A C*, viz. *A D* or *C D*, gives the content in feet, which divide by 100, gives the ſquares, or by 9, gives ſquare yards.

Thus, *A C*, 24 feet, multiplied by $\frac{1}{2}$ *B D*, 16 feet, (viz. 8 feet) gives 192 feet, viz. 1 ſquare, 92 feet: or divide by 9, gives $21\frac{3}{9}$ ſquare yards of plaiſtering, and thus for any other triangle.

3. *Of* BOARD *and* TIMBER-MEASURE.

1. If the board be regular, multiply the length in inches, by the breadth in inches, and divide by 144, gives the anſwer; or, multiply the length in feet by the breadth in inches, and divide by 12, gives the anſwer.

Queſt. 7. There is a board 9 feet long, and 10 inches wide; how many feet does it contain? *Anſ.* 7 $\frac{1}{2}$ feet.

If the board be wider at one end than the other, add the breadth of both ends together, and take the $\frac{1}{2}$ for a mean breadth; then multiply the length by this mean breadth in inches (as before directed) and divide by 144.

Queſt. 8. There is a board 16 inches at one end, and 8 at the other, and 10 feet long; what is the content? *Anſ.* 10 feet.

Note, If a board, &c. be very irregular, take the breadth in ſeveral places at equal diſtances: Add all the breadths together, and divide the ſum by the number of them for the mean breadth; and then proceed as before.

By the Slip or Sliding Rule.

The ſeventh QUESTION *proved.*

Set the breadth of the board, viz. 10 inches, on the ſlip, to the upper 12 above on the rule; then againſt 9 feet on the rule, you have 7½ feet on the ſlip, the content required.

Again, Suppoſe a board be 14 feet long, and 15 inches wide, what is the content? Set 15 on the ſlip, againſt the upper 12, then, againſt 14 feet on the rule, you have 17½ feet on the ſlip, anſwer.

Tyro. I underſtand you, Sir; but pray how do you meaſure timber?

Philo. The cuſtomary way is this: with a ſmall ſtring or cord, take the circumference of the tree (which is done in any place, where the buyer and ſeller can agree); then double this ſtring into four parts, and apply it to your rule, and that length is called the girt, or ¼ part of the circumference; and it is cuſtomary to abate one inch of the girt on account of the bark.

2. Having got the girt, multiply it by itſelf, that is, ſquare it, and multiply that product by the length of the tree in feet, and divide by 144, gives the content; or multiply it by the length in inches, and divide by 1728, gives the content.

Note, Few perſons mind leſs than ½ a foot in the length of a tree, except it be very large.

Queſt. 9. There is a tree 14 inches girt, and 9 feet long, I demand the content? *Anſ.* 12¼ feet.

Firſt, 14 multiplied by 14, is 196, this × 9, the length, = 1764, which divided by 144, gives 12 feet, 36 inches, which is ¼ of 144, viz. 12¼ feet content.

Queſt. 10. There is a tree 10½ inches girt, and 12½ feet long, I demand the content? *Anſ.* 9½ feet. For $10.5 \times 10.5 = 110.25 \times 12.5 = 1376.125 \div 144 = 9.57$ feet, or 9 feet, 82 inches, *Anſ.*

By the Slip or Sliding Rule.

The ninth QUESTION *proved.*

Set the length of the tree on the ſlip (viz. 9 feet) againſt 12 in the middle of the rule (wrote girt-line) then againſt the girt (viz. 14) on the girt-line, you have 12½ feet on the ſlip.

The tenth QUESTION *proved.*

Set 12½, the length, againſt 12, the girt-line; then againſt 10½, you have better than 9½ on the ſlip itſelf, viz. 9 feet, 82 inches.

Of tapering Timber.

Some perſons will take but one girt, though a tree be very long and tapering; but this is certainly very wrong, as it may do injuſtice to either the buyer or ſeller. The beſt way is, to meaſure ſuch a tree, as if it were two or three diſtinct trees, by taking two or three ſeveral lengths and girts.

Some, indeed, take two girts, one at the great, and the other at the ſmall end, and add them together, and take the half of it for a mean girt (as in board meaſure) but this is very erroneous; for they ſhould multiply one girt by the other, and to the product add one third part of the ſquare of the difference of the girts, and then extract the ſquare root for a mean girt. Or rather, multiply by the length, after adding $\frac{1}{3}$ of the ſquare of the difference as before directed, without finding a mean girt, and the content will be the ſame.

Queſt. 11. Suppoſe a tree 20 inches girt at one end, and 40 at the other, and 9 feet long (through the center), I demand the content?

By the cuſtomary way the mean girt will be 30 inches, and the content will be 56 feet, 36 inches = $\frac{1}{4}$ of another foot. But, according to the true way, the mean girt is 30.55 inches, and the content $58\frac{1}{3}$ feet, which is $2\frac{1}{12}$ feet more than the other.

Tyro. This is a ſenſible difference indeed, in many loads of timber.

Philo. Very true.

Note 1. In ſome countries, 40 feet make a load, and in others, 50 feet make a load.

Note 2. When there are 50 feet to the load, then to caſt up the content, at any given price, the rule is, multiply the content or number of feet by the price in ſhillings, and cut off the three firſt figures from the right to the left hand: ſo will the figures towards the left hand be pounds ſterling, and the other will be decimal parts of a £.

EXAMPLE.

Queſt. 12. Suppoſe I meaſured 6 trees, and their content be 548 feet, at £. 1 - 10*s.* per load?

I multiply 548 by 30, and it gives 16440, which I cut off thus, 16|440, and it is £. 16.440, viz. £. 16-8-9½.

N. B. Stone is meaſured the ſame, only obſerve 8 inches make 1 foot of ſtone.

4. *Of* BRICK-WORK.

Tyro. How is brick-work meaſured?

Philo. By the ſquare rod, that is 16½ feet in length, and 16½ in breadth, make 272¼ feet, or one ſquare rod; but for common practice, 272 feet only is ſufficient.

Tyro. Is there not a certain ſtandard for the thickneſs of brick-work?

Philo. Yes, all ſorts of brick-work is reduced to the ſtandard of 1½ brick thick, of which I ſhall give you a farther notion by and by.

1. *Of Work at 1½ Brick thick the Standard.*

Multiply the length by the height in feet, and divide by 272, the quotient gives the ſquare rods, and the remainder the feet or parts of a rod.

Queſt. 13. A gentleman built a brick-wall round his garden, which was 998 feet long, 9 feet high, and 1½ brick in thickneſs: I demand how many rods it contains? *Anſ.* 33 rods, 6 feet.

Here I multiply 998, the length, by 9, the height, and it gives 8982 feet, which I divide by 272, (the feet in a rod) and it gives 33 rods, 6 feet. *Anſ.*

Tyro. I underſtand it; this is eaſy enough: but ſuppoſe it was but 1 brick thick, or ſuppoſe it were two or three bricks thick, how then?

Philo. Having found the content at 1½ brick thick, as before directed, ſay thus: As 3 (the ½ bricks in the ſtandard-meaſure) is to the content in ſtandard-meaſure) at 1½ brick thick, ſo is the number of half bricks in the wall to the content, at that thickneſs.

Queſt. 14 Let the wall be 998 feet round, and 9 feet high, as before, what is the content, at 2½ bricks thick?

The content at 1½ thick was found in the laſt queſtion to be 33 rods, 6 feet. Say therefore,

As 3 to 33.6, ſo is 5 half-bricks, viz. the thickneſs at 2½ bricks thick, to the content at that thickneſs, viz. 55 rods, 10 feet.

Tyro. I underſtand you well; but cannot any thickneſs be done at one operation?

Philo. Yes; for having multiplied the length by the height, divide by any of the following numbers, that are ſet againſt the given thickneſs, and you have the content in rods at once, and the remainder is feet.

Note, Though there be decimals in the diviſors, you may divide by whole numbers for common uſe.

For 1	Brick thick divide by	408.3	For 3½	Bricks thick divide by	116.6
1½		272.25	4		102.1
2		204.2	4½		90.7
2½		163.3	5		81.7
3		136.12			

Queſt. 15. There is a wall 15.5 feet long, and 9.5 feet high; what is the content, at 3½ bricks thick? *Anſ.* 1 rod, 2 tenths: for I multiply 15.5×9.5=147.25, which divided by 116.6, the diviſor for 3½ bricks, gives 1 rod, 2 tenths: And thus for any thickneſs; for at 4½ thick, it is 1.5 rod, viz. 1½.

By the Slip or Sliding Rule.

There is a wall 9 feet high, and 76 feet long, and 1½ brick thick; I demand the content? *Anſ.* 2 rods, 140 feet, or better than 2½ rods.

Set 272 on the ſlip to the height 9 above it; then againſt 76, the length on the ſlip, is 2½ or better, on the rule.

A RULE *for any Thickneſs.*

Set any of the former diviſors, anſwering any thickneſs on the ſlip, to the height; then againſt the length is the anſwer.

Thus, the ſame wall at 3 bricks thick: Set 136 to 9, then againſt 76 you have 5 rods, the content at 3 bricks thick.

5. *Of* SURVEYING.

Tyro. How is land ſurveyed?

Philo. Land-Meaſure is a part of the mathematics, and to ſurvey it true, and in a maſterly manner, you ſhould be provided, 1. With a chain called Gunter's chain. 2. A caſe of inſtruments. 3. A parallel ruler. 4. A plain table. 5. A plotting-ſcale, or protracter. And, to make it more complete, a theodolite.

Tyro. But cannot I meaſure a common regular field, or little piece of ground, without all theſe inſtruments?

Philo. Yes; by a chain only; or for want of that, a cord, a rod-pole, or any ſuch thing; but this muſt not be depended upon for truth.

Tyro. Give me a deſcription of the chain.

Philo. All land is now generally meaſured by a chain, containing 4 rods, or poles, in length, (viz. 22 yards) according to a ſtatute made in the 33d of Edward I. anno 1235, which ſays, that a ſquare acre ſhall contain 160 rods, viz. 40 rods in length, and 4 rods in breadth, make 160 rods, or 1 acre of ground.

Note, The chain is made of iron, containing 100 links, each in length is 7.92 inches or nearly 8 inches, 100 of which are 792 inches, or 22 yards, (viz. 4 rods) therefore, 1 chain in length, and 10 in breadth, or 10 in length and 1 in breadth, make an acre.

Note 2. For want of a chain you may take a cord 22 yards, or four rods long, or any number of rods long you pleaſe, dividing it into halves and quarters, with which you may meaſure any common field within a trifle of truth, or, at leaſt, for common ſatisfaction.

Having provided yourſelf with a chain, or any convenient line, if the field or piece of ground be regular, viz. a ſquare, or the oppoſite ſides alike; then meaſure the length and the breadth, in rods or parts, and multiply the length by the breadth, and divide the product by 160, the rods in an acre, you have the content.

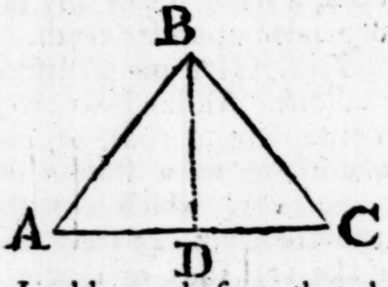
Queſt. 5. There is a field in the form of a long ſquare (called a parallelogram) whoſe length is 35 rods, and breadth 24 rods, I demand the content in acres? *Anſ.* 5 acres 1 rood.

Firſt, I multiply 35, the length, by 24, the breadth, and it gives 840 rods; which I divide by 160, gives 5 acres, and 40 remain, which I multiply by 4 (becauſe 4 roods make 1 acre) and divide again by 160, gives 1 rood.

Queſt. 16. There is a ſquare piece of ground ſet out upon a heath or common, in order to form a camp for 1000 ſoldiers, each ſide contains 60 rods: how many acres does it contain? *Anſ.* 22½ acres.

For 60×60=3600, which divide by 160=22 acres, 80 rods, or 22½ acres.

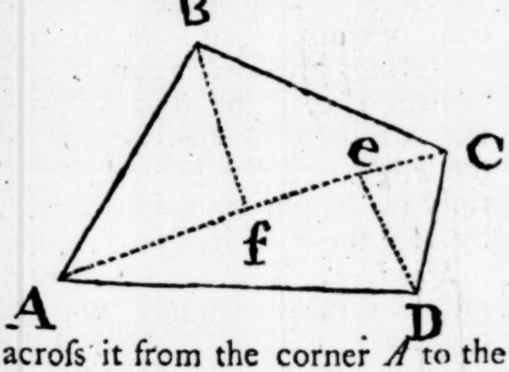
Queſt. 17. There is a 3-ſided or triangular field, *ABC*, the ſide *AC* is 51.5 rods, and the perpendicular *BD* is 34 rods; how many acres does it contain? *Anſ.* 5½ acres nearly.



Note, You muſt firſt of all meaſure the ſide from *A* to *C*, called the baſe, which ſuppoſe 51½ rods; then meaſure half way from *A* to *C*, and from *D* meaſure ſtraight up the point *B*, which is called the perpendicular, which ſuppoſe to be 34 rods, now, I told you before, that the baſe multiplied by half the perpendicular gives the content; that is 51.5 multiplied by half the perpendicular 17, gives 875.5, which divided by 160, gives 5.47 acres, that is, very near 5½ acres.

To meaſure any four-ſided Field, whoſe Sides are unequal, called a Trapezium.

Queſt. 18. There is a trapezium, or four-ſided field or piece of ground, *ABCD*, whoſe baſe *AC* is 64 rods, and the perpendicular *Bf* is 60, and the other perpendicular *De* is 40: I demand the content in acres? *Anſ.* 20 acres.



Firſt, to meaſure this field, go ſtraight acroſs it from the corner *A* to the corner *C*, which here is called the baſe, and meaſures 64 rods: then meaſure right ſtraight from the point *B* to *f*, which is 60 rods, and right ſtraight from *D* to *e*, which is 40 rods. This done, the rule is,

Multiply the whole baſe *A C* 64 by $\frac{1}{2}$ *B f* 60 (viz. 30) and it gives 1920 rods, the content of the triangle *A B C*; then again multiply the baſe *A C* by $\frac{1}{2}$ *D e* 40 (viz. 20) and it gives 1280 rods, the content of the triangle *A C D*. Add thoſe two together, viz. 1920, and 1280 rods, gives 3200 rods, which divide by 160, the rods in an acre, gives 20 for the anſwer.

Tyro. Sir, I thank you; this is enough for my purpoſe at preſent.

Philo. If the field has more ſides, you may meaſure it after the ſame manner, by dividing it into triangles, always remembering to multiply the baſe by $\frac{1}{2}$ every perpendicular that falls upon it.

6. *Of* GAUGING.

Tyro. How may I guage, or tell the content of any common cooler, or regular caſk, or ciſtern, in gallons, or buſhels.

Philo. I ſhall give you ſome ſhort inſtructions, by which you may tell the content of ſeveral things near enough truth, for your own ſatisfaction; but to be a practical gauger, you ought to underſtand ſeveral branches of the mathematics.

1. *To tell the Content of a Malt Ciſtern in Gallons and Buſhels.*

Queſt. 19. There is a ciſtern 6.5 feet long, 4 feet wide, and 3.5 feet deep: I demand its area and content in gallons and malt buſhels?

Note 1. Area ſignifies the ſuperficial content, or content at one inch deep; which multiplied by the depth, gives the content itſelf.

Note 2. That 282 inches make 1 gallon of ale, water, &c. 231 a gallon of wine, and 2150 inches one buſhel, which are your diviſors for all regular figures.

RULE.

Multiply the length, 78 inches, by the breadth, 48, and it gives 3744 inches, which divide by 282, gives 13.276, the area, at one inch deep; or divide by 2150, gives 1.741, the area in buſhels. The area multiplied by the depth, 42 inches, gives 557.592 gallons. The area for malt multiplied by 42, gives 73.122, the content in buſhels.

Note, If the area be not required, or you do not underſtand decimals, you may more eaſily find the content at once, thus: Multiply the length, breadth, and depth, in inches, together, gives 157248, which divide by 282, gives 557$\frac{1}{2}$ gallons; 157248, divided by 2150, gives 73 buſhels $\frac{1}{10}$, as before.

To find the Area by the Sliding Rule.

Set 282 upon *B* to 48, the breadth, on *A*; then againſt 78, the length, on *B*, is 13.277, the area in gallons.

For malt, ſet 2150 on *B* to 48 on *A*; then againſt 78, the length, on *B*, is 1.741 on *A*, the area in buſhels; and thus for any regular figure.

To gauge a Tub or Cooler, in the Form of a Cylinder, viz. whoſe Top and Bottom Diameters are equal.

RULE.

Square the diameter, viz. multiply it by itſelf, and this product by the depth, then divide by 359 for beer gallons, 294 for wine, and 2737 (or rather by 2737.47) for malt.

Queſt. 20. There is a tub 4 feet 2 inches diameter, and 3 feet 4 inches deep: I demand the content in beer, wine, and malt?

I ſquare the diameter 50, which is 2500, and multiply this by the depth, 40 inches, gives 100000; which divide by 359, gives 278 ale gallons; divide by 294, gives 340 wine gallons, and by 2737 only, gives 36.5 malt buſhels.

Note, If the figure be the form of a triangle, or trapezium, (as in *queſtions* 17 and 18) you muſt proceed to meaſure them as there directed, and after having multiplied by the depth, divide 282 for beer, 231 for wine, and 2150 for malt, gives the content.

Queſt. 21. There is a tub, whoſe top diameter is 40 inches, bottom 30 inches, and the depth 60 inches: I demand the content in beer, wine, and malt?

There are ſeveral ways to do this; but the moſt eaſy and expeditious is as follows: Add the diameters together, and take the half (viz. 35) for a mean diameter. Now $35\times35=1225\times60=73500$, which divided by 359, gives about 205 gallons; and ſo for malt, viz. 2737, gives 26 buſhels $\frac{8}{10}$.

Note, This method gives the content ſomewhat leſs than the truth; but the error is ſo very trifling, unleſs the tub, &c. taper very much, that it is not worth regarding in practice: The rule given by the author, in the former editions, for finding a mean diameter is ſo far from correcting this error, that it conſiderably augments it; for, in the preſent caſe, the true mean diameter is not 34.64 (as he makes it) but 35.115, and the content 206 beer gallons and about a pint.——*Editor*.

For a Couch of MALT.

1. If it be a regular ſquare only, multiply the length, breadth, and depth together, and divide by 2150, gives the buſhels.

2. If it be a triangle, or trapezium, proceed as before directed, and divide ſtill by 2150.

Tyro. But ſuppoſe the couch be uneven, how ſhall I tell where to take the depth?

Philo. Take the depth at four or five places, add them all together, and divide by the number of places you took the depth at, for a mean depth.

Queſt. 22. There is a bed or couch of malt, in the form of a long ſquare, whoſe length is 35 feet, breadth

16 feet, and I find the mean depth to be 8.5 inches, viz. 8½ inches; I demand the content?

Thus, 420 inches × 192 = 80640 × 8.5 = 685440; this divided by 2150, gives 318.8 buſhels.

Of CASK GAUGING.

There is a great variety in gauging caſks; but the following methods will be near enough truth for all common caſks; ſuch as barrels, butts, &c. that are pretty much bulged.

Firſt, Having taken the bung and head diameters, the rule is, to the ſum and ½ the ſum of the ſquares of the bung and head diameters add ½ the difference of the ſaid ſquares: this ſum multiply by the length, and divide by 1077 for beer, or 882 for wine gallons.

2. *Rule*, which is as true, and much eaſier.

To the double ſquare of the bung diameter add the ſquare of the head diameter; then multiply this ſum by the length of the caſk, and divide by 1077 for beer, or 882 for wine.

Queſt. 23. There is a caſk, whoſe bung diameter is 28 inches, head diameter 25 inches, length 36: I demand the content in ale gallons?

Firſt, the ſquare of the bung diameter 28 is 784; which doubled is 1568. Then the ſquare of the head, viz. 25 × 25 = 625, which added to 1568, is 2193; this × 36, the length, is 78948, which divided by 1077, gives 73 gallons, 2 pints, for beer, and divided by 882, gives 89 gallons and ½, wine or brandy.

Note, If you find the area of the bung and head diameters (by *queſtion* 20) and add twice the area of the bung, viz. 2.184, to the area of the head 1.741, it is 6.109, which multiplied by ⅓ of the caſk's length, viz. 12, gives 73.308 gallons, as before.

Theſe methods holding good for moſt caſks, I ſhall give no more examples.

Note 2. If one of the head diameters be larger than the other, and the caſk is ſtraight in the ſides, like ſome churns, then (by *queſtion* 21) find a mean diameter throughout, and proceed as therein directed.

7. *Of* CROSS MULTIPLICATION.

There are two Methods.

1. *By* MULTIPLICATION *only.*

1. *Rule.* Feet multiplied by feet produce feet.
2. Inches multiplied by feet, or feet by inches, produce inches.
3. Inches multiplied by inches produce parts.

Note, 12 ſeconds make 1 part, 12 parts make 1 inch, and 12 inches 1 foot.

2. *By* MULTIPLICATION *and* DIVISION.

Rule. Having placed the leſſer ſum for the multiplier, multiply the very laſt place of the multiplicand towards the right hand by the firſt place or name of the multiplier, and carry one for every 12, ſetting down what is over 12 under the part you multiplied, then take the parts of the multiplier as in practice, carrying as before 1 for every 12.

But an example will render it more eaſy, if I give it both ways.

	Feet	*In.*	*Parts*		*Feet*	*In.*
Multiply	4	3	6	*by*	4	3
by	4	3				
	17	2	-			
	1	-	9			
			1	6		
Anſ.	18	2	10	6		
	Feet	*In.*	*P.*	*Sec.*		

Firſt, I begin and multiply the top 4 feet, 3 inches, and 6 parts, by 4 feet, (carrying 1 for every 12) ſaying, 4 times 6 is 24 parts, that is, 0 and carry 2; then 4 times 3 is 12, and 2 I carried is 14 inches, that is, 2 inches, and carry 1 to the feet; then 4 times 4 is 16 feet, and 1 is 17.

Secondly, I multiply now 4 feet, 3 inches, 6 parts, by the lower 3 inches, ſaying, 3 times 4 is 12 inches (becauſe feet multiplied by inches are inches) then 3 times 3 inches is 9 parts, (for inches by inches produce parts) and laſtly, three times 6 parts is 18 parts, viz. 1 part, 6 ſeconds.

The Second Method.

I firſt multiply the firſt or top line as before, and find it as before, 17-2-0; and now I take the parts, as in Practice; ſaying, 3 inches is ¼ of a foot, &c. See the work.

		Feet	*In.*	*P.*		
		4	3	6		
		4	3			
In.		17	2	-		
3	¼	1	-	10	6	
		18	2	10	6	as before.

I ſay, 3 inches is ¼ of a foot, and take the parts from 4 feet, 3 inches, 6 parts, ſaying, the 4th of 4 is 1 foot; then the 4th of 3 inches, 6 parts, (viz. 42 parts) is 10 times 4 is 40, and 2 parts over; laſtly, I ſay the 4th of 2 parts (viz. 24 ſeconds) is 6 ſeconds; which is now done in 2 lines only.

And now, *Tyro*, I muſt bid you farewell, and I hope you will take care to improve yourſelf in them, rather than trifling away your time with idle fancies; for it is evident, that the knowledge of arithmetic is neceſſary in every ſtation of life, ſince almoſt all manner of buſineſs depends upon it: and not only this, *Tyro*, but it is a great help to protect us againſt the frowns of fortune, and keep us (by being qualified for ſome lawful poſt or employment) from thoſe common temptations and misfortunes, to which thoſe, who know the want of it, ſo often fall into, and pay for ſo dearly.

Tyro. I return you thanks for this advice, and hope I ſhall make ſuch uſe of it as may not fruſtrate your good deſigns.

Philo. I make no doubt but you will. And therefore —I once more bid you an hearty farewell.

Tyro. Sir, I am your humble ſervant.

APPENDIX:

CONTAINING

A CONCISE METHOD

OF

BOOK-KEEPING.

RUDIMENTS of BOOK-KEEPING.

THE greateſt advantage neceſſary for Youth, muſt proceed from a right knowledge and practice of keeping orderly accounts.

To anſwer this end, I have formed an eaſy ſcale, whereby any one capable of ſubtracting one ſum of money from another, may ſtate and balance their own accounts correctly, and have a clear view of all their tranſactions.

RULES *for knowing the Debtor in all Circumſtances.*

Every thing I receive is Debtor to the perſon from whom received: And every perſon to whom I give, is Debtor to the thing given.

Again, if I exchange one article for another, the article received is Debtor to the one given.

WASTE BOOK.

London, January 1, 1787.

INVENTORY of the READY MONEY, GOODS, and DEBTS, belonging to me, A. B. taken this day, viz.

	£.	s.	d.	£.	s.	d.
In ready money ——	857	10	0			
40 bales of broad cloth, at 35*l.* per bale ——	1400	0	0			
12 hhds. of ſugar, wt. 175 *C.* 1 *qr.* at 32*s.* 6*d.* *per Cwt.*	284	15	7½			
150 bags of ginger, wt. 175 *C.* at 24*s.* ——	210					
70 anchors of brandy, at 62*s.* 6*d.* ——	218	15				
William James owes me on demand ——	80	10				
Abraham Green, per bond, due 4th *Feb.* next	100					
				3151	10	7½
I owe as follows:						
To John Worthy, on demand	80					
To James Innis, per bond with intereſt, from 4th *June*, 1784 ——	500					
				580	0	0

January 2, 1787.	£.	s.	d.
Bought 17 pipes of ſherry of Wm. James, at £ 42 *per* pipe	714	0	0
Sold 1 hhd. of ſugar, wt. 16 *C.* 2 *qrs.* neat, to John Ingram, at 37*s.* 6*d.* *per C.*	30	18	9
Sold 4 bales of broad cloth, for ready money, at £. 40 *per* bale	160	0	0
Sold William Manners 5 hhds. of ſugar, weight 70 *C.* 1*qr.* 18 *lb.* at 38*s.* *per C.*	133	15	7¼
3			
Bartered with William Davis 10 pipes of ſherry, at £. 43 *per* pipe	430	0	0
For 9 puncheons of rum, quantity 958 gallons, at 6*s.* 6*d.*	311	7	0
Bought a ſilver tea-kettle and lamp, for which I paid	20	0	0
Paid for a ſet of books for my compting-houſe	5	5	0
Paid my houſekeeper her bill of expences	32	14	6½
4.			
My warehouſe-keeper has informed me of the ullage of ½ the pipe of ſherry, bought of Wm. James, which I value at	21	0	0
Sold 4 ankers of brandy, for ready money, at 67*s.* 6*d.* *per* anker	13	10	0
Received by the hands of Thomas Williamſon, in full of a legacy left me by my uncle, John Roberts	520	0	0
Paid my book-keeper his quarter's ſalary, and bill of charges	34	18	9
Sold 2 punch. of rum, quant. 245 galls. at 10*s.* 6*d.* *per* gallon, for ready money	128	12	6
Gave as a benefaction to the *Saliſbury* Infirmary	50	0	0
Sold the remainder of my ſherry, being 6 pipes and 1 hhd. at £. 47 *per* pipe, to William James	305	10	0

JOURNAL.

N. B. The figures in the left-hand column refer to the folios of the Ledger, where the accounts are transferred to; and when this mark ✓ is put, it denotes that the article is poſted in the Ledger.

		London, *January* 1, 1787.				£.	s.	d.
		Sundry Accounts, £.3151-10*s.* 7½*d.* Dr. to Stock.						
			£.	*s.*	*d.*			
✓	2	Caſh in ready money	857	10				
✓	1	Broad cloth for 40 bales, at £.35 *per* bale ——	1400	0	0			
✓	3	Sugar for 175 *C.* 1 *qr.* at 32*s.* 6*d.* *per C*	284	15	7½			
✓	3	Ginger, for 175 *C.* at 24*s.* *per C.* —	210	0	0			
✓	2	Brandy, for 70 ankers, at 62*s.* 6*d.* ——	218	15	0			
✓	2	Wm. James, on demand	80	10	0			
✓	3	Abraham Green, *per* Bond, due 4th *Feb.* next ——	100	0	0	3151	10	7½
	1	Stock, £.580 to ſundry Accounts.						
✓	3	To John Worthy, on demand ——	80	0	0			
✓	3	To James Innis, *per* bond, with intereſt, from *June* 4, 1784	500	0	0	580	0	0

		January 2, 1787.	£.	*s.*	*d.*
✓	4/2	Sherry, £.714 to William James, For 17 pipes, at £.42 ——	714	0	0
✓	4/3	John Ingram, £.30 - 18*s.* 6½*d.* to ſugar For 1 hhd. wt. 16 *C.* 2 *qrs.* at 37*s.* 6*d.*	30	18	9
✓	2/1	Caſh £.160 to broad cloth For 4 bales, at £.40 ——	160	0	0
✓	4/3	Wm. Manners, £.133 - 15*s.* 7¼*d.* to ſugar For 5 hhds. wt. 70 *C.* 1 *qr.* 18 *lb.* at 38*s.* *per C.* ——	133	15	7¼
		3.			
✓	4/4	William Davis, £.430 to ſherry * For 10 pipes, delivered to him in barter, at £.43 ——	430	0	0
✓	4/4	Rum, £.311-7*s.* to William Davis* For 9 puncheons, quant. 958 galls. at 6*s.* 6*d.* received in barter	311	7	0
✓	5/2	Plate and jewels, £.20 to caſh Paid for a tea-kettle and lamp	20	0	0
✓	5/2	Charges of merchandize, £.5 - 5*s.* to caſh Paid for a ſet of books for the 'compting-houſe ——	5	5	0
✓	5/2	Houſe expences, £.32 - 14*s.* 6½*d.* to caſh Paid my houſe-keeper's bill of expences —— ——	32	14	6½
		4.			
✓	1/4	Profit and Loſs, £.21 to ſherry For the ullage of ½ a pipe ——	21	0	0

* Theſe are two Journal Poſts in the caſe of Barter.

		January 4, 1787.	£.	*s.*	*d.*
√	2/2	Caſh £. 13 - 10*s.* to brandy For 4 ankers, at 67*s.* 6*d.* *per* anker	13	10	0
√	2/1	Caſh £. 520 to Profit and Loſs Received a legacy left me by my uncle Roberts ——	520	0	0
√	5/2	Charges of merchand. £. 34 - 18*s.* 9*d.* to caſh Paid my book-keeper a quarter's ſalary, and bill of charges —	34	18	9
√	2/4	Caſh £. 128 - 12*s.* 6*d.* to rum For 2 punch. 245 galls. at 10*s.* 6*d.*	128	12	6
√	1/2	Profit and Loſs, £. 50 to caſh Gave to the *Saliſbury* Infirmary	50	0	0
√	2/4	William James, £. 305 - 10*s.* to ſherry For 6 pipes and 1 hhd. at £. 47 *per* pipe — ——	305	10	0

LEDGER.

A	
B	
Broad Cloth	1
Brandy	2
Balance	5
C	
Caſh	2
Charges of Merchand.	5
D	
Davis, William	4
E	
F	

G	
Ginger	3
Green, Abraham	3
H	
Houſe Expences	5
I	
James, William	2
Innis, James	3
Ingram, John	4
K	
L	
M	
Manners, William	4

N		T	
O		U	
P		W	
Profit and Loſs	1	Worthy, John	3
Plate and Jewels	5		
Q		X	
R		Y	
Rum	4		
S		Z	
Stock	1		
Sugar	3		
Sherry	4		

Dr.—Stock.

	Folio in Journal		Folio in Ledger	£.	s.	d.
1787 Jan. 1.	1	To ſundry accounts, as *per* Journal		580	0	0
		To balance for the neat of my eſtate	5	3083	12	1
				3663	12	1

Dr.—Profit and Loſs.

	Folio in Journal		Folio in Ledger	£.	s.	d.
1787 Jan. 4.	2	To ſherry for 1 hhd. ullaged	4	21	0	0
4.	3	To caſh gave the *Saliſbury* Infirmary	2	50	0	0
		To houſe expences	5	32	14	6½
		To charges of merchandize	5	40	3	9
		To ſtock gained by trade	1	512	1	5½
				655	19	9

Dr.—Broad Cloth.

	Folio in Journal		Folio in Ledger	£.	s.	d.
1787 Jan. 1.	1	To ſtock, at £.35 per bale, for 40 bales	1	1400	0	0
		To profit and loſs gained	1	20	0	0
				1420	0	0

Per Contra—Cr.

	Folio in Journal		Folio in Ledger	£.	s.	d.
1787						
Jan. 1.	1	By ſundry accounts, as *per* Journal ——		3151	10	$7\frac{1}{2}$
		By profit and loſs, gained by trade ——	1	512	1	$5\frac{1}{2}$
				3663	12	1

Per Contra—Cr.

	Folio in Journal		Folio in Ledger	£.	s.	d.
1787						
Jan. 4.	3	By caſh for a legacy left by uncle Roberts ——	2	520	0	0
		By broad cloth gained ——	1	20	0	0
		By brandy gained ——	2	1	0	0
		By ſugar gained ——	3	23	9	9
		By ſherry gained ——	4	42	10	0
		By rum gained ——	4	49	0	0
				655	19	9

Per Contra—Cr.

	Folio in Journal			Folio in Ledger	£.	s.	d.
1787							
Jan. 2.	2	By caſh at £. 40 *per* bale, for	4 bales	2	160	0	0
		By bal. remaining at £. 35 *per* bale, for	36	5	1260	0	0
			40		1420	0	0

Dr.—Brandy.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 1.	1	To ſtock, at 62*s.* 6*d.* *per* anker, for 70 ankers —	1	218	15	0
		To profit and loſs gained	1	1	0	0
				219	15	0

Dr.—Caſh.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 1.	1	To ſtock in ready money	1	857	10	0
2.	2	To broad cloth for 4 bales, at £.40 *per* bale —	1	160	0	0
3.	3	To brandy for 4 ankers, at 67*s.* 6*d.* *per* anker —	2	13	10	0
		To profit and loſs, received a legacy left me by uncle Roberts — —	1	520	0	0
		To rum, for 245 gall. at 10*s.* 6*d.*	4	128	12	6
				1679	12	6

Dr.—William James.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 1.	1	To ſtock, *per* note on demand	1	80	1	0
4.	3	To ſherry, for ſix pipes, 1 hhd. at £.47 *per* pipe —	4	305	10	0
		To balance due —	5	328	0	0
				714	0	0

Per Contra—Cr.

	Fol. in Jour.			Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 4.	3	By caſh at 67*s.* 6*d. per* anker, for	4 an.	2	13	10	0
		By balance remaining at 62*s.* 6*d. per* anker	66	5	206	5	0
			70		219	15	0

Per Contra—Cr.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 3.	2	By plate and jewels, for one tea-kettle and lamp ——	5	20	0	0
		By houſe expences, paid houſe-keeper's bill ——	5	32	14	6½
		By charges of merchandize, paid for 1 ſet of books ——	5	0	5	0
		By ditto, paid book-keeper's ſalary, and bill of charges	5	34	18	9
4.	3	By profit and loſs, gave the *Saliſbury* Infirmary —	1	50	0	0
		By balance remaining in my hands ——	5	1536	14	2½
				1679	12	6

Per Contra—Cr.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 2.	2	By ſherry, for 17 pipes, at £. 42	4	714	0	0
				714	0	0

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
		Dr.—Sugar.				
1787 *Jan.* 1.	1	To ſtock, at 32*s*. 6*d*. *per C.* for 175 *C.* 1 *qr.*	1	284	15	7½
	1	To profit and loſs gained	1	23	9	9
				308	5	4½
		Dr.—Ginger.				
1787 *Jan.* 1.	1	To ſtock, at 24*s*. *per C.* for 175 *C.* ——	1	210	0	0
		Dr.—Abraham Green.				
1787 *Jan.* 1.	1	To ſtock, *per* bond, due the 4th of *Feb.* next ——	1	100	0	0
		Dr.—John Worthy.				
1787 *Jan.*		To balance due ——	5	80	0	0
		Dr.—James Innis.				
1787 *Jan.*		To balance due ——	5	500	0	0

Per Contra—Cr.

	Fol. in Jour.		C.	qr.	lb.	Fol. in Ledg.	£.	s.	d.
1787 Jan. 2.	2	By John Ingram, 37*s*. 6*d*. *per C*. for	16	2	0	4	30	18	9
		By Wm. Manners, 38*s*. *per C*. for	70	1	18	4	133	15	7¼
		By balance rem. at 32*s*. 6*d*. for	88	1	10	5	143	11	0¼
			175	1	0		308	5	4½

Per Contra—Cr.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 Jan.		By balance remaining at 24*s*. for 175 *C*. ——	5	210	0	0

Per Contra—Cr.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 Jan.		By Balance due —	5	100	0	0

Per Contra—Cr.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 Jan.		By ſtock, on demand —	1	80	0	0

Per Contra—Cr.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 Jan.		By ſtock, *per* bond, dated 4th *June*, 1780 ——	1	500	0	0

Dr.—Sherry.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 2.	2	To Wm. James, at £.42 *per* pipe, for 17 pipes —	2	714	0	0
		To profit and loſs gained		42	10	0
				756	10	0

Dr.—John Ingram.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 2.	2	To ſugar, for 1 hhd. wt. 16 *C.* 2 *qrs.* at 37*s.* 6*d.* —	3	30	18	9

Dr.—William Manners.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 2.	2	To ſugar, for 5 hhds. wt. 70 *C.* 1 *qr.* 18 *lb.* at 38*s.* —	3	133	15	7½

Dr.—William Davies.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 3.	2	To ſherry, for 10 pipes, at £.43 dd. in barter —	4	430	0	0

Dr.—Rum.

	Fol. in Jour.		Fol. in Ledg.	£.	s.	d.
1787 *Jan.* 3.	2	To W. Davis, received in barter, at 6*s.* 6*d.* 958 gall. —	4	311	7	0
		To profit and loſs gained	1	49	0	0
				360	7	0

Per Contra—Cr.

	Fol. in Jour.		P. H.	Fol. in Ledg.	£.	s.	d.
1787							
Jan. 3.	2	By W. Davis, dd. in barter, at £.43 for	10 0	4	430	0	0
4.	2	By profit and loſs, for an ullage of ——	0 1	1	21	0	0
	3	By W. James, at £.47 for	6 1	2	305	10	0
			17 0		756	10	0

Per Contra—Cr.

	Fol. in Jour.			Fol. in Ledg.	£.	s.	d.
1787							
Jan.		By balance due ——		5	30	18	9

Per Contra—Cr.

	Fol. in Jour.			Fol. in Ledg.	£.	s.	d.
1787							
Jan.		By balance due ——		5	133	15	7¼

Per Contra—Cr.

	Fol. in Jour.			Fol. in Ledg.	£.	s.	d.
1787							
Jan. 3.	3	By rum, for 958 gall. at 6*s.* 6*d.*		4	311	7	0
		By balance due ——		5	118	13	0
					430	0	0

Per Contra—Cr.

	Fol. in Jour.		*Gall.*	Fol. in Ledg.	£.	s.	d.
1787							
Jan. 4.	3	By caſh, at 10*s.* 6*d.* for	245	2	128	12	6
		By bal. rem. at 6*s.* 6*d.* for	713	5	231	14	6
			958		360	7	0

	Fol. in Jo.		Fol. in L.	£.	s.	d.
		Dr.—Plate and Jewels.				
1787 *Jan.* 3.	2	To caſh, for tea-kettle and lamp	2	20	0	0
		Dr.—Houſe Expences.				
1787 *Jan.* 3.	2	To caſh, paid my houſekeeper's bill ——	2	32	14	6½
		Dr.—Charg. of Merchand.				
1787 *Jan.* 3.	2	To caſh, paid for a ſet of books	2	5	5	0
4.	3	To caſh, paid book-keeper's ſalary and bill ——	2	34	18	9
				40	3	9
		Dr.—Balance.				
		To caſh remaining —	2	1536	14	2½
		To broad cloth rem. 36 bales, at £.35 ——	1	1260	0	0
		To brandy rem. 66 ankers, at 62*s.* 6*d.* ——	2	206	5	0
		To ſugar rem. 88 *C.* 1 *qr.* 10 *lb.* at 32*s.* 6*d.* ——	3	143	11	0¼
		To ginger rem. 175 *C.* 1 *qr.* at 24*s.* ——	3	210	0	0
		To Abraham Green, *per* bond, due 4th of *Feb.* next	3	100	0	0
		To Wm. Manners, on demand	4	133	15	7¼
		To Wm. Davies, on demand	4	118	13	0
		To rum rem. 713 gall. at 6*s.* 6*d.*	4	231	14	6
		To John Ingram, on demand	4	30	18	9
		To plate and jewels ——	5	20	0	0
				3991	12	1

	Fol. in Jo.		Fol. in L.	£.	s.	d.
		Per Contra—Cr.				
1787 *Jan.*		By balance remaining —	5	20	0	0
		Per Contra—Cr.				
1787 *Jan.*		By profit and loſs —	1	32	14	6$\frac{1}{2}$
		Per Contra—Cr.				
1787 *Jan.*		By profit and loſs —	1	40	3	9
		Per Contra—Cr.				
		By Wm. James, on demand	2	328	0	0
		By John Worthy, ditto	3	80	0	0
		By James Innis, *per* bond, dated 4th *June*, 1780 —	3	500	0	0
		By ſtock, the neat of my eſtate	1	3083	12	1
				3991	12	1

Neceſſary Obſervations.

The Debtor ſide of the Account of Balance (ſee fol. 5) contains what goods remain in your hands unſold, what debts are due, what caſh you have in your poſſeſſion, and whatever elſe of worth belong to you, from which is always formed the Inventory for a new Waſte Book. It is alſo an account of your ready money, goods, debts, &c. and the Credit ſide an account of the ſeveral ſums you owe.

After the Account of Stock (which is the laſt cloſed but the above) is made Debtor to Balance for the neat of your eſtate, and the Account of Balance credited by Stock for the ſame ſum, you have then nothing to do but add your Credit ſide of Balance, and if it amounts to the ſame ſum as the Debtor ſide, you are certain of its being true.

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